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ABSTRACT

This resource guide is designed for teachers of introductory college chemistry classes. The topics chosen represent those areas most frequently studied. For each of the 33 topics, the following are included: content errors which have appeared in textbooks, references (primarily paperback), films, teaching aids, selected lecture demonstrations, and black-on-white transparency masters. A comprehensive checklist of minimum design standards for chemistry classrooms is included. (RS)

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TOPICS-AIDS

INSTRUCTIONAL RESOURCES FOR GENERAL CHEMISTRY

SE 010 604

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TOPICS-AIDS

INSTRUCTIONAL RESOURCES FOR GENERAL CHEMISTRY

by

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Additional copies of this publication are available free of charge upon request to:

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PREFACE

This collection is designed to help in planning both the content and presentation of an introductory chemistry course. The topics chosen were selected as representing those areas most frequently discussed in both majors and non-majors programs. It is hoped that the individual teacher will add other topics, or expand on those included herein, to make a total collection of value in his own unique teaching situation. If this booklet provides a useful format and a nucleus for a personalized catalog of teaching supplements, the editors will feel well rewarded.

Rod O'Connor
Harry Zeitlin
Ann Zeitlin

1970

ACKNOWLEDGEMENTS

To Hubert Alyea, Fred Dutton, and Dick Powell - those masters of innovative teaching - for their advice and cooperation in this effort; to Gordon Barrow, Bill Cook, Carroll King, and the Executive Committee of the Advisory Council on College Chemistry for their encouragement and support; to Bob Barnard, Bill Eberhardt, and Tom Lippincott for their magnificent efforts in the Journal of Chemical Education; to Mrs. Juanita Maier for her work in assembling this manuscript; to Ken Finan for preparation of the illustrations; to Roger Gymer for shepherding the manuscript through final production; and to the Dee Tozer Agency for printing and distribution of the booklet - the warmest thanks from the editors.

Rod O'Connor
Harry Zeitlin
Ann Zeitlin

1970

DEDICATION

To the students in general chemistry
courses in colleges and universities.

The future is yours. May we, as
teachers, not obstruct your paths.

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TOPICS-AIDS

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- THE CHEMISTRY CLASSROOM -

In spite of numerous efforts to publicize useful criteria for classroom design, it is still common for new construction to include classrooms poorly planned and inadequately equipped for advantageous use of modern teaching aids. The following checklist should be considered as furnishing the minimum requirements for design of new classrooms or renovation of existing facilities for chemistry teaching. Additional features may be added as determined by local requirements and budgets.

CHECKLIST

Minimum Standards for Chemistry Classrooms

Feature	Room Size (Seating Capacity)		
	less than 50	50-150	more than 150
General Layout	rectangular seats facing shorter wall parallel rows side aisles	rectangular seats facing shorter wall parallel rows side aisles + optional center aisle (narrow) sloping or stepped floors for larger rooms high ceiling	rectangular or modified wedge seats facing shorter wall parallel or semi-parallel rows wide side aisles + narrower center aisle (one or more) sloping or stepped floors high ceiling
Access	front and rear cart access to lecture area	rear for main traffic cart access to lecture area	rear for main traffic emergency exits as needed cart access to lecture area side exits optional as traffic pattern requires
Windows	none or A-V drapes	none or A-V drapes	none or A-V drapes, controlled from lecture area
Lighting	fluorescent or (better) incandescent in rows switched parallel to front of room switches near door and at lecture area	directional incandescent system onto writing surfaces for note taking and onto blackboard additional fluorescent system for use during full illumination switches near door and at lecture area	same as 50-150 seat room lecture area spotlights optional red, non-glare exit signs
Ventilation	standard	standard optional downdraft hood on lecture bench	standard downdraft hood on lecture bench
Seating	movable chairs fixed tablet arms under-seat book storage some left-hand tablet arms	fixed chairs fixed or movable tablet arms under-seat book storage some left-hand tablet arms	same as 50-150 seat room or, better, flip-partition continuous writing tables with under-table storage shelf and fixed swivel seats

Lecture Area (Allow adequate front-of-room space for overhead projectors)	small fixed table 110 volt outlets on table and on floor (for overhead projector) Lecture Area Control System, convenient location, conduit to projection area fire extinguisher	medium fixed bench with lockable cabinets roll-in table to match bench gas, electricity, water, sink on bench 110 volt overhead projector outlet on floor Lecture Area Control System, convenient location, conduit to projection area fire extinguisher	same as for 50-150 seat room, except increase bench size to accomodate downdraft hood 110 volt outlets on floor for two overhead projectors Lecture Area Control System, convenient location, conduit to projection booth P.A. System, wireless Lecture bench TV system optional Telephone connection through P.A. fire extinguisher
Lecture Area Control System	one-unit, lockable panel for: lights (banks) projectors, including remote focus and slide-changer	one-unit, lockable panel for: lights projectors, including remote focus and slide-changer (random-access preferred)	one-unit, lockable panel for: lights P.A. system projectors, including remote focus, random-access slide control, stop-frame control for motion picture TV (optional) Response System (optional)
Projection System	overhead projector (horizontal stage) pull-down screen (6' x 6') which can be slanted to avoid Keystone effect roll-in cart with 35mm, Super-8, and 16mm projectors (remote controls) 110 volt outlets in back of room roll-in TOPS projector optional	overhead projector (horizontal stage) one fixed screen (8' x 8'), slanted to avoid Keystone effect one pull-down screen (8' x 8') roll-in cart or lockable stand with 35mm, Super-8, and 16mm projectors (remote controls) 110 volt outlets in back of room roll-in TOPS projector optional	two overhead projectors (one horizontal, one TOPS) two fixed screens (8' x 8', or larger for larger rooms), slanted to avoid Keystone effects one pull-down screen (10' x 10' or larger), motorized optional one lockable projection booth with 35mm, Super-8, and 16mm projectors (remote controls) plus space and outlets for additional projectors
Preparation Area	access for roll-in cart	access for roll-in cart	adjoining room for preparing and testing demonstrations and for storing teaching aids

The Journal of Chemical Education frequently contains useful articles related to design and use of instructional facilities. Of particular value to faculty considering renovation or new construction is the series "The Modern Chemistry Classroom", edited by Dr. W. Robert Barnard. The following are highly recommended:

Barnard, W. Robert, Lagowski, J. J., and O'Connor, Rod, "The Modern Chemistry Classroom", J. Chem. Ed., 45, 63-70 (1968)

Barnard, W. Robert, "8mm Projectors in the Modern Chemistry Classroom", J. Chem. Ed., 45, 136-139 (1968)

Barnard, W. Robert, Kelley, John C., Gidden, Robert, and Eberhardt, Wm., "A Lecture Room Digital Multimeter", J. Chem. Ed., 45, 206-208 (1968)

Barnard, W. Robert, "Overhead Projectors", J. Chem. Ed., 45, 341-346 (1968)

Barnard, W. Robert, "Projection Screens and Chalkboards in the Modern Chemistry Classroom", J. Chem. Ed., 45, 543-546 (1968)

Barnard, W. Robert, Bertaut, E. F., and O'Connor, Rod, "Television for the Modern Chemistry Classroom: Part I (Tested Applications)", J. Chem. Ed., 45, 617-20 (1968)

Barnard, W. Robert, "Television for the Modern Chemistry Classroom: Part II (Hardware)", J. Chem. Ed., 45, 681-684 (1968)

Barnard, W. Robert and O'Connor, Rod, "Television for the Modern Chemistry Classroom: Part III (New Projects, Future Developments)", J. Chem. Ed., 45, 745-749 (1968)

RECOMMENDED GENERAL RESOURCES

1) Lecture Demonstration Booklets

   a. Tested Demonstrations in Chemistry, Alyea, H. N. and F. Dutton (editors), 6th ed., Chemical Education Publishing Co., (1965), 20th and Northampton Streets, Easton, Pennsylvania 18042, $3.50

   b. TOPS in General Chemistry, Alyea, H. N., 3rd ed., Chemical Education Publishing Co., (1967), 20th and Northampton Streets, Easton, Pennsylvania 18042, $3.50

   c. Micro-Chemistry Projected, Alyea, H. N., (1968), order from Hubert N. Alyea, 337 Harrison Street, Princeton, N. J. 08540 - $4.00

2) Continuing Resources

A number of excellent publications are available to teachers of chemistry. Chemical and Engineering News frequently contains interesting articles on new advances in research, technology, and education. The British journal Education in Chemistry (published by The Royal Institute of Chemistry, 30 Russell Square, London WC1, England) has numerous useful features, including regular reviews of instructional motion pictures. Many of the publications designed for high school science teachers, such as "The Science Teacher", National Science Teachers Association, 1201 16th Street, N.W., Washington, D.C., often have appropriate materials for introduction college courses.

Certainly every chemistry teacher should regularly scan the Journal of Chemical Education. In addition to the excellent articles of a subject-matter nature, particular attention should be given to such continuing features as "Textbook Errors" and "Tested Demonstrations". Annual listings of paperback references are published and a wide variety of instructional aids are advertised.

3) Useful Tables of Data

   a. Handbook of Chemistry and Physics (college edition), The Chemical Rubber Company, 2310 Superior Avenue, Cleveland, Ohio 44114, new editions annually.

   b. The Merck Index, (8th ed., 1968), Merck and Co., Inc., Rahway, N. J., new editions periodically.

   c. Chemical Data Book, (2nd ed., 1966), Aylward, G. H. and T. J. V. Findlay, John Wiley and Sons, 605 Third Avenue, New York, N. Y. 10016

   d. Discovery of the Elements, (7th ed., 1965), Weeks, Mary E. and Henry M. Leicester, Chemical Education Publishing Co., 20th and Northampton Streets, Easton, Pa. 18042 - $12.50

4) Model Preparation

   a. Models in Structural Inorganic Chemistry, A. F. Wells, Oxford University Press, 200 Madison Avenue, New York, N. Y. (1970) - cloth, $7.20, paper, $4.25

   b. Atomic, Molecular, and Crystal Models, Edmund Scientific Co., Barrington, N. J. 08007 - $0.50

5) 35mm Color Slides

   a. Masterson and Slowinski: Color Slides to accompany Chemical Principles, W. B. Saunders Co., West Washington Square, Philadelphia, Pa. 19105 - $125. for set of 120 2-color slides

   b. Color Slides of Chemical Phenomena (1968) - write for descriptive information from KODANSHA Co., Ltd., Bunkyoku, Tokyo, Japan

6) Programmed Instructional Materials (General)

   a. Barrow, G., et al., Understanding Chemistry (one-vol. ed.), W. A. Benjamin, Inc., $3.95 (1970)

   b. Caldwell, W. E., Chemistry Simplified: A Programmed Review Based on Your Course, Vols. I and II, (1968), Barnes and Noble, $2.25 each volume.

The Format of TOPICS-AIDS

There are as many ways of approaching the subject of chemistry as there are teachers in the field. The sequence of topics in this booklet is selected as representing a fairly conventional format for an introduction to chemistry. For each topic in the sequence the following items are included:

a. Textbook Errors Summary
(Based on Serial Publication No. 25 of the Advisory Council on College Chemistry, as prepared by F. M. VanMeter and W. H. Eberhardt, as published in J. Chem. Ed., 44, 356 (1967), with later additions.)

b. References
(Primarily current paperbacks).

c. Selected Films
(16mm sound and Super-8 silent films).

d. Other Teaching Aids
(Models, apparatus, programmed materials, etc.).

e. Selected Lecture Demonstrations
(Both unpublished and references to published demonstrations).

f. Transparency Master
(Back of topic page).

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All materials included have been arbitrarily selected by the editors who apologize for any errors or omissions.

*All prices quoted on commercial materials are only approximate. Current catalogs should be consulted before ordering. College audiovisual bureaus may help in locating films for rental rather than purchase.

1) ATOMIC STRUCTURE

a. Textbook Errors Summary

PADDLE-WHEEL CROOKES TUBE, Campbell, J. A., J. Chem. Ed., 38, 480 (1961)

In the paddle-wheel Crookes tube the paddle wheel does not move because of the momentum of the electrons striking it. The electron momentum force is found to be far too small to cause motion; rather, the mechanism is the same as that of the radiometer.

b. References

1. ATOMS, FIRE, WAVES, or WHAT?, Johnson, E. N., J. Chem. Ed., 37, 267 (1960)
2. Explaining the Atom, Hecht, S., Viking, 256 pp. (1964) - $1.45
3. Focus on Physics - Atomic Physics, Stearns, R. L., Barnes and Noble (1969) - $1.25
4. The Structure of Atoms, Lagowski, J. J., Houghton-Mifflin, 120 pp. (1964) - $2.25
5. The World of Physics, Beiser, A. (ed.), McGraw-Hill (1967) - $2.95

c. Selected Films

1. Mass of the Electron - MLA, cat. no. 0413, $90. (15mm, B/W, sound, 18 min.)
2. Millikan Experiment - MLA, cat. no. 0404, $150. (16mm, B/W, sound, 30 min.)
3. Rutherford Atom - MLA, cat. no. 0416, $150. (16mm, B/W, sound, 40 min.)
4. Rutherford Scattering - HR, cat. no. 80-3965, $25. (S-8, color, silent, 4 min.)
5. Thomson Model of the Atom - EAL, cat. no. 80-3957, $23. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - MLA ($1.50 each)
   cat. no. 0955 - Thomson's e/m Experiment
   cat. no. 0964 - Rutherford Scattering
   cat. no. 0965 - Energy Hill Analog
   cat. no. 0966 - Proton-Proton Repulsion

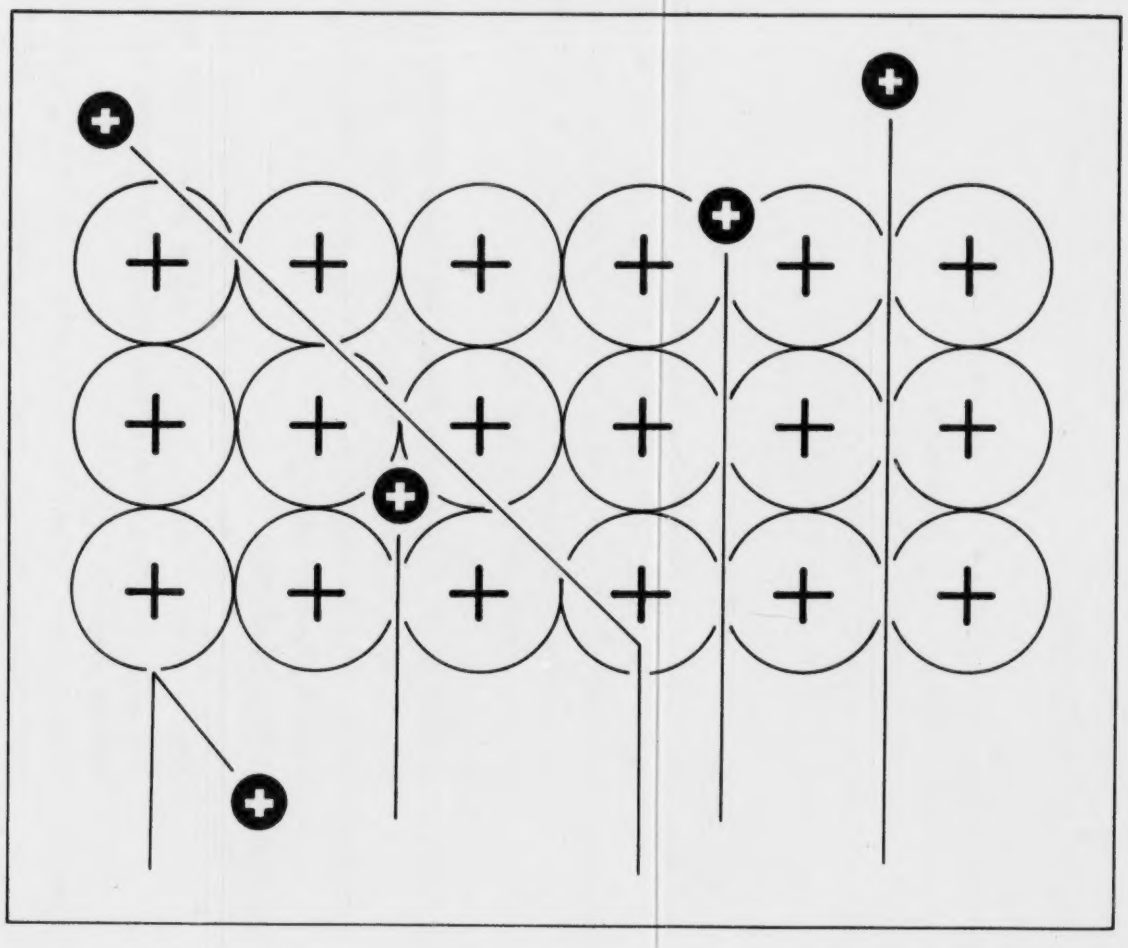
e. Selected Lecture Demonstrations

1. Electrostatics
   Materials: Two pith balls connected by long string, overhead projector, amber or hard rubber rod, glass rod, cat's fur, piece of silk, 10" x 10" acetate, marking pen.
   Procedure: Hang pith balls from head of overhead projector so that shadows of balls are projected onto a screen. Charge balls +, +; -, -; -, +, labeling charges each time on acetate on projector surface.
2. Magnetic Deflection of Electron Beam
   Materials: Deflection e/m tube (Ealing Corp., cat. no., A33-5257), power supply (Ealing Corp., cat. no. A28-1303), magnet (Ealing Corp., cat. no. A33-5026).
   Procedure: Connect tube to display electron beam, darken room, show beam deflection by N and S poles of magnet.
3. Modified Rutherford Experiment
   Materials: Geiger-Muller Counter (suitable for α-detection) with meter display and audio output, swivel clamp for G-M tube, alpha source, lead foil with circular hole, thin gold (or other metal) foil, overhead projector, acetate, two colored marking pens.
   Procedure: Mount G-M tube perpendicular to α-beam. Swivel tube at various angles and plot count rate vs. angle on overhead projector. Insert metal foil in α-path and repeat measurements, using new color for plotting data.

f. Transparency Master

"The Nuclear Atom"

THE NUCLEAR ATOM



2) NUCLEAR STRUCTURE

a. Textbook Errors Summary

ATOMIC MASSES, BINDING ENERGIES, AND ISOBARIC STABILITY, Poe, A. J., J. Chem. Ed., 37, 92 (1960)

Increase in binding energy is usually given as a criterion of spontaneity in a nuclear reaction. This is correct in certain cases, e.g., α-decay and fission, but incorrect for isobaric decay (β-emission and electron capture). The basic criterion of spontaneity is that there should be a decrease in mass in the reaction.

b. References

1. Basic Concepts of Nuclear Physics, Stearns, R. L., Reinhold Book Corp., 160 pp. (1968) $2.95
2. The Heart of the Atom, Cohen, Bernard L., Doubleday, 107 pp. (1967) - $1.25
3. Introduction to the Atomic Nucleus, Cuninghame, J. G., American Elsevier, 231 pp. (1964) $4.75
4. The Neutron Story, Hughes, Donald J., Doubleday, 158 pp. (1959) - $1.25
5. Nuclei and Radioactivity: Elements of Nuclear Chemistry, Choppin, Gregory R., Benjamin, 160 pp. (1964) - $2.95

c. Selected Films

1. Exploring the Atomic Nucleus - CORF, B/W, $75.; color, $150. (16mm, sound, 13 1/2 min.)
2. The Nuclear Structure - UEVA, $105. (16mm, B/W, sound, 19 min.)
3. Radioactive Decay - HR, cat. no. 80-2009, $19. (S-8, color, silent, 4 min.)
4. Radioactivity - HR, cat. no. 80-3346, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Transparencies - MLA ($1.50 each)
   cat. no. 0969 - Mass Spectrometer
   cat. no. 0970 - Cloud Chamber
   cat. no. 0972 - Plot of Number of Neutrons vs. Number of Protons in Some Atoms
   cat. no. 0973 - Binding Engergy per Nucleon for Natural Isotopes vs. Mass Number
   cat. no. 0974 - Compound Nuclei
2. Models of Mass Spectrometers
   Norton, F. J., J. Chem. Ed., 25, 677 (1948)
   Fernandez, J. and Lebowitz, S. H., J. Chem. Ed., 26, 334 (1949)

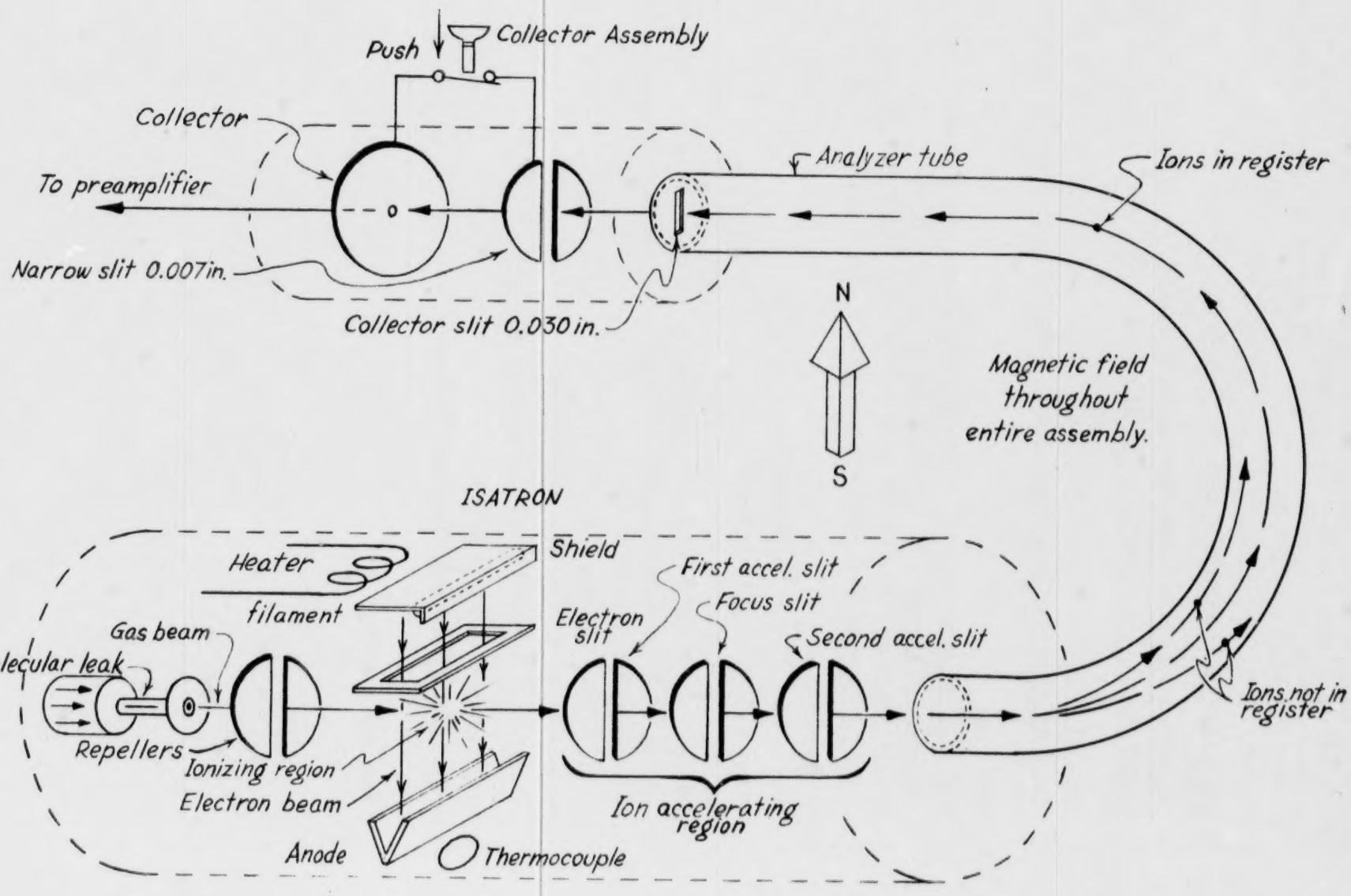
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 21, 87, 89, 104, 120, 131, 185.

f. Transparency Master

"Mass Spectrometer"

MASS SPECTROMETER



3) ELECTRON CONFIGURATION

a. Textbook Errors Summary

ENERGY LEVEL DIAGRAMS AND EXTRANUCLEAR BUILDING OF THE ELEMENTS, Keller, R. N., J. Chem. Ed., 39, 289 (1962)

A relative order of stability of atomic orbitals is usually stated. The order of stability will often change with changes in the nuclear charge or number of electrons surrounding the atom.

THE SHAPE OF THE 2p AND RELATED ORBITALS, Cohen, Irving, J. Chem. Ed., 38, 20 (1961)

The shape of a 2p orbital is often represented by a graph of the angular part of the 2p wave function. To show the true shape of an orbital, the total wave function must be used.

THE FIVE EQUIVALENT d ORBITALS, Powell, Richard E., J. Chem. Ed., 45, 45 (1968)

Several textbooks assert that there is no way of choosing the five d orbitals so that they have the same shape but differ only in their orientation; and, so far as the writer is aware, no textbook author has written down such a set of d orbitals. Yet, as early as 1940, George E. Kimball, in his classic memoir on the application of group theory to directed valence, pointed out that five equivalent d orbitals could be directed along the slant edges of a pentagonal pyramid.

b. References

Behavior of Electrons in Atoms: Structure, Spectra, and Photochemistry of Atoms, Hochstrasser, R. M., Benjamin, 174 pp. (1964) - $2.95

c. Selected Films

1. The Hydrogen Atom (As Viewed by Quantum Mechanics) - advanced version, MLA, cat. no. 4149, $150. (16mm, color, sound, 20 min.)
2. Matter Waves - MLA, cat. no. 0423, $150. (16mm, color, sound, 28 min.)
3. Teacher Training Introduction to "The Hydrogen Atom" - MLA, cat. no. 4049, $50. (16mm, B/W, sound, 9 min.)
4. The Principle of Uncertainty - ROB, cat. no. 6, $180. (16mm, B/W, sound, 30 min.)

d. Other Teaching Aids

1. Transparencies - MLA
   cat. no. 0960 - Energy Level Diagram for Hydrogen Atom
   cat. no. 0961 - Bohr Hydrogen Atom
   cat. no. 0962 - Some Common Spectra
2. An Aid to Teaching Electronic Configuration of Atoms, Sanderson, R. T., J. Chem. Ed., 37, 262 (1960)

e. Selected Lecture Demonstrations

1. Uncertainty

   Materials: Large balloon or lightweight "beach ball", overhead projector, acetate, marking pen, blindfolds for students.

   Procedure: Toss ball to students and have them pass it around. Plot "path" on overhead projector. Then have students blindfold each other. Toss ball to group with instructions, "As soon as you touch the ball, hit it away." After appropriate interval, have blindfolds removed and ask students "Who touched it first, second, third, etc.? Well, who touched it sometime?" Plot "probability map" and discuss problem of determining "path".

2. Continuous and Discontinuous Spectra

   Materials: Powerful white light source, prism, materials for flame tests on various salts, gas discharge tubes and power set-up. (Alternative to prism: student spectroscopes - REC, cat. no. 32580, $.30 each.

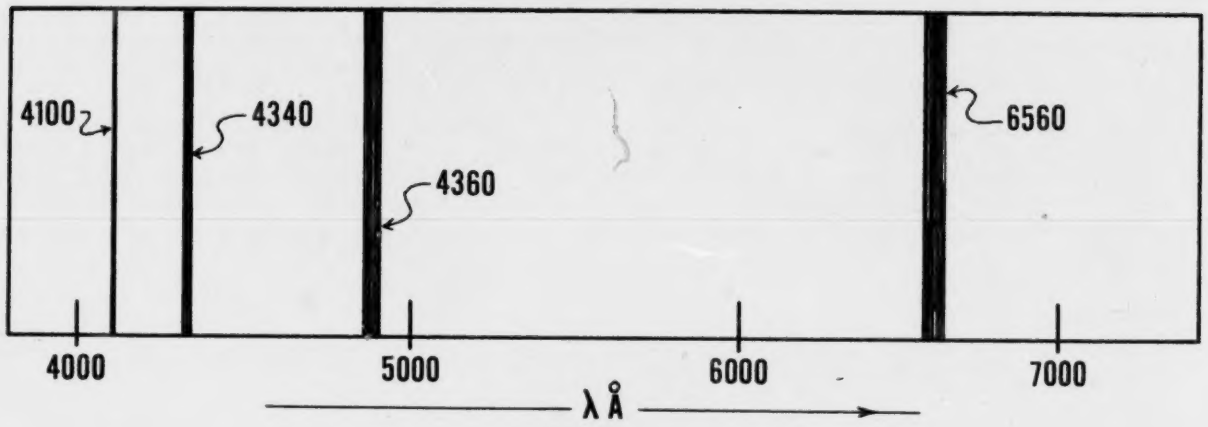
   Procedure: Darken room, compare continuous and discontinuous spectra.

f. Transparency Master

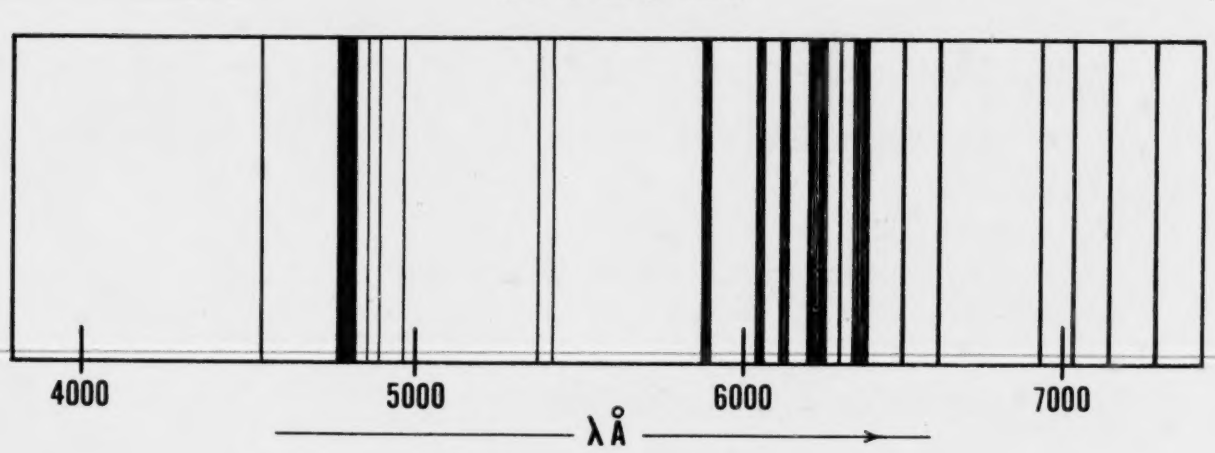
"Line Spectra"

SOME TYPICAL LINE SPECTRA

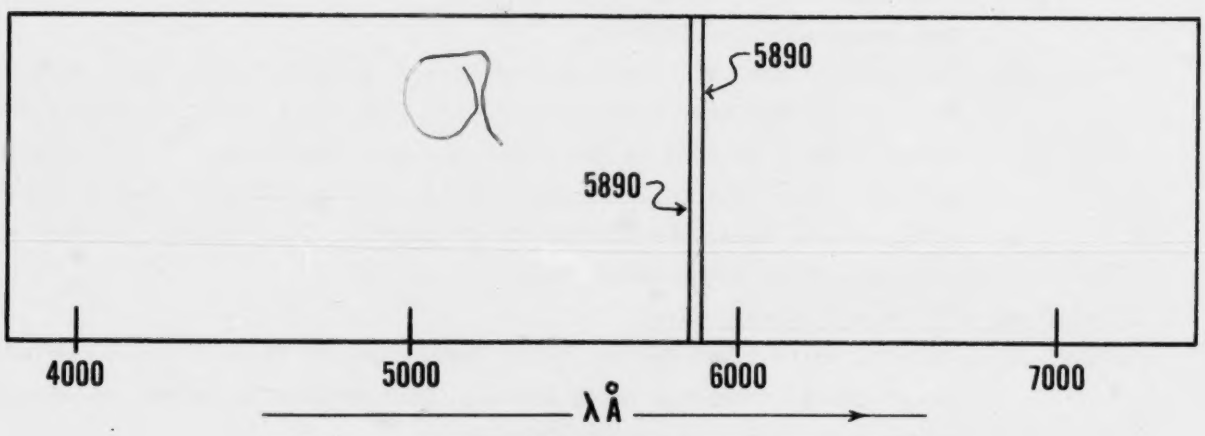
VISIBLE REGION ONLY



Hydrogen
(gas discharge tube)



Neon
(gas discharge tube)



Sodium ion
(flame emission)

4) IONIC BONDING

a. Textbook Errors Summary

None reported

b. References

1. Atomic Structure and Valency, Stevens, B., Barnes and Noble, 103 pp. (1967) - $1.75
2. The Chemical Bond, Lagowski, J. J., Houghton-Mifflin, 208 pp. (1966) - $2.95
3. Classics in the Theory of Chemical Combination, Benfey, O. Theodor, Dover, 221 pp., (1963) - $2.00
4. Valence and the Structure of Atoms and Molecules, Lewis, Gilbert Newton, Dover, 172 pp., (1966) - $1.50

c. Selected Films

1. Ionization Energy - MLA, cat. no. 4151, $165. (16mm, color, sound, 22 min.)
2. Electric Interactions in Chemistry - MLA, cat. no. 4109, $165. (16mm, color, sound, 21 min.)
3. Ionization - CORF, B/W, $105.; color, $210. (16mm, sound, 18 1/2 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - REC

cat. no. 21717 - Boundary Contours of Atomic Orbitals - $4.90

cat. no. 21718 - Atomic Orbitals of the Period 2 Elements - $11.50

cat. no. 21719 - Electronic Configuration of the Elements in Period 1, 2, and 3 - $1.50

cat. no. 21721 - Approximate Energy Levels of Electrons - $7.00

cat. no. 21726 - Ionization-Energies - $4.90

cat. no. 21727 - Size and Ionization Energy (IA) - $4.90

cat. no. 21728 - Size and Ionization Energy (IIA) - $4.90

cat. no. 21730 - Ion Formation - $4.90

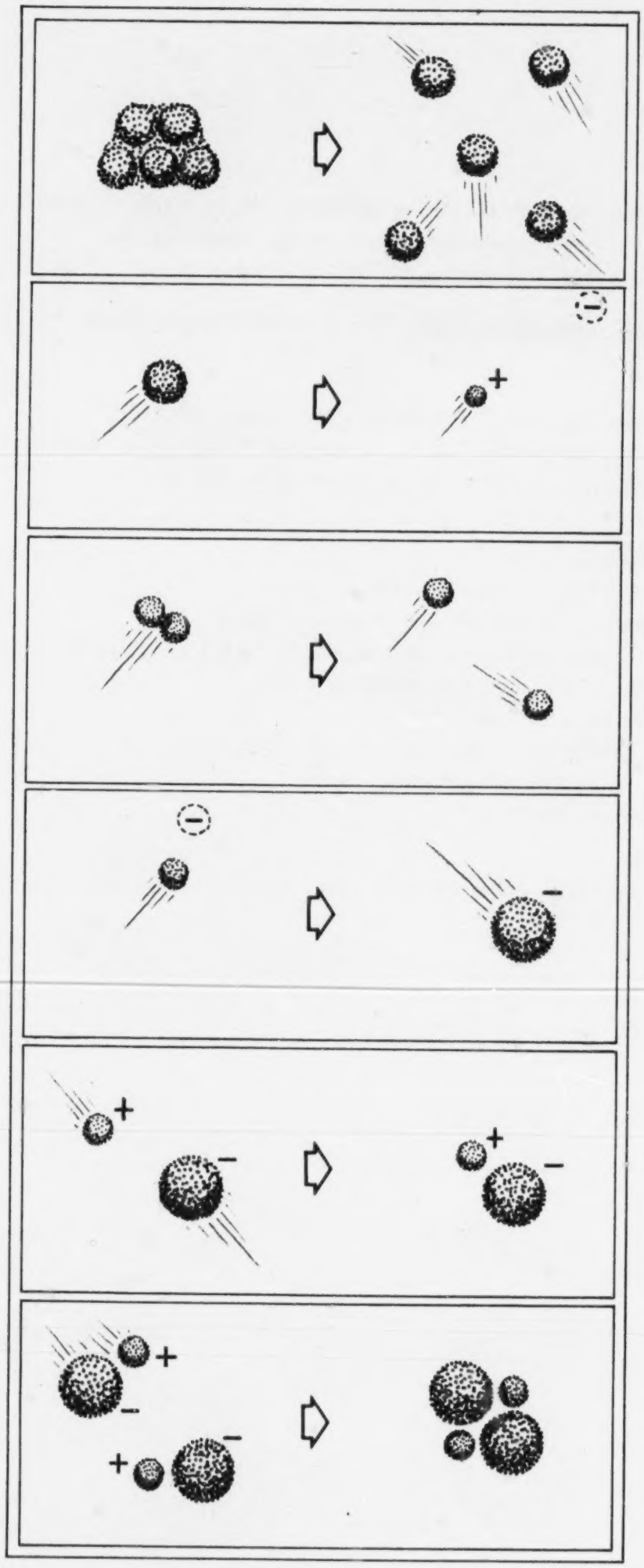
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 15, 74-76, 148, 163, 164.

f. Transparency Master

"Born-Haber Cycle"

BORN-HABER CYCLE



$Li_{(s)} \longrightarrow Li_{(g)}$
(requires energy)

$Li_{(g)} \longrightarrow Li^{+}_{(g)} + e^{-}$
(requires energy)

$F_{2(g)} \longrightarrow 2F_{(g)}$
(requires energy)

$F_{(g)} + e^{-} \longrightarrow F^{-}_{(g)}$
(releases energy)

$Li^{+}_{(g)} + F^{-}_{(g)} \longrightarrow LiF_{(g)}$
(releases energy)

$n\ LiF_{(g)} \longrightarrow (LiF)_{n(s)}$
(releases energy)

5) COVALENT BONDING

a. None reported

b. References

1. Atomic and Molecular Structure: A Pictorial Approach, Wahl, A., McGraw-Hill, 150 pp. (1969) - $3.95
2. Bonding and Structure: A Review of Fundamental Chemistry, Margolis, Emil J., Appleton-Century-Crofts, 175 pp. (1968) - $3.50
3. Chemical Bonding Clarified Through Quantum Mechanics, Pimentel, George C. and Richard D. Spratley, Holden-Day, Inc., 339 pp. (1969) - $4.50
4. Chemical Bonding and Structure, Griswold, Ernest, Raytheon Education Co., 128 pp. (1968) $2.50
5. Electron Repulsion Theory of the Chemical Bond, Luder, W. Fay, Reinhold Book Corp., 128 pp. (1968) - $3.50
6. From Vital Force to Structural Formulas, Benfey, O. Theodor, Houghton-Mifflin, 115 pp. (1964) - $2.25
7. The Importance of Anti-Bonding Orbitals, Orchin, Milton and Hans H. Jaffe, Houghton-Mifflin, 104 pp. (1967) - $2.50
8. Orbitals and Chemical Bonding, Lynch, P. F., Houghton-Mifflin, 56 pp. (1969) - $1.75

c. Selected Films

1. Atomic and Bonding Orbitals - WIL, 8mm $17.; S-8 $19. (color, silent, 4 min.)
2. Chemical Bonding - MLA, cat. no. 4057, $120. (16mm, color, sound, 16 min.)
3. The Properties of a Covalently Bonded Molecule - LGC, cat. no. E/66A, $9. (8mm, color, silent, 3 min.)
4. Simple Molecular Orbitals - HR, $25. (S-8, color, silent, 4 min.)
5. Atoms to Molecules - MGHT, (8 Film Series), $180, (S-8, color, silent, 4 min. each)

d. Other Teaching Aids

1. Atomic and Molecular Structure (4 wall charts) - MGHT, $125.
2. Models:

   Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 51, 121, 122.
3. New type demonstration and student models - Write for brochure from Science Related Materials, Inc., P. O. Box 1009, Evanston, Illinois 60204

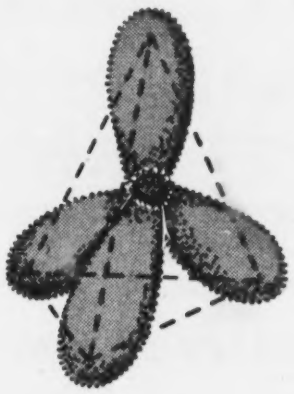
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 36, 37, 39, 42, 47, 48, 107-113, 148.

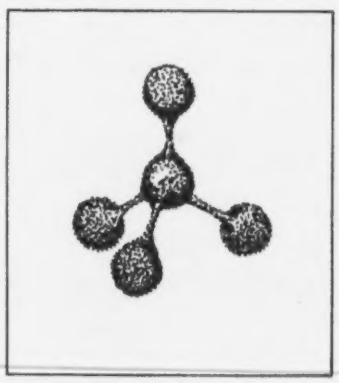
f. Transparency Master

"sp^3 Hybrids and Tetrahedral Molecules"

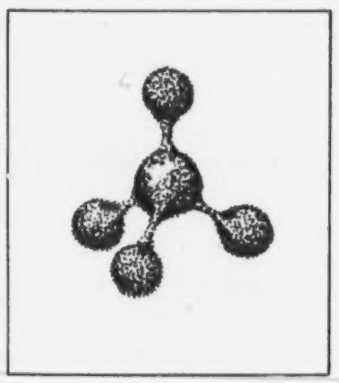
sp^3 HYBRIDS AND TETRAHEDRAL MOLECULES



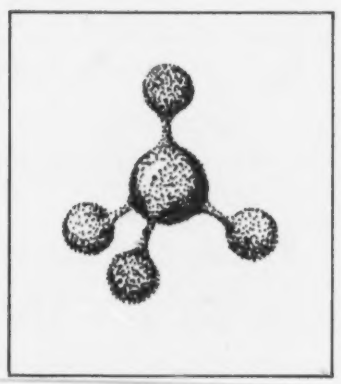
Bond angles 109.5°



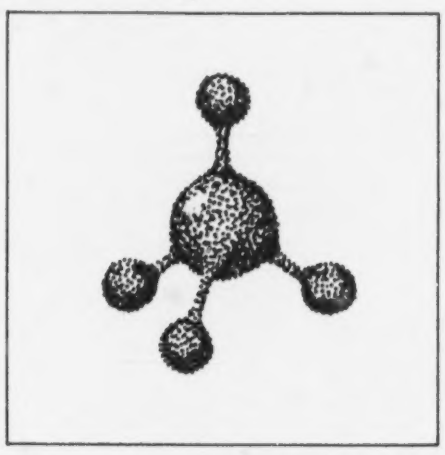
Methane (CH_4)



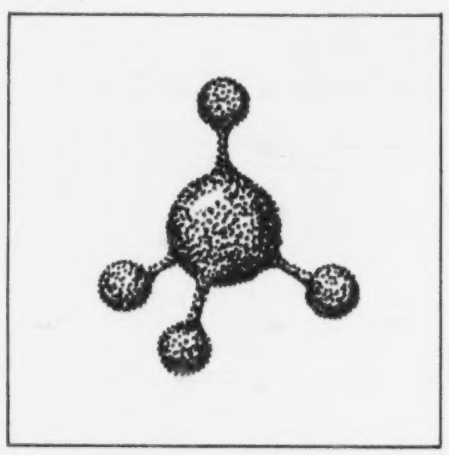
Silane (SiH_4)



Germane (GeH_4)



Stannane (SnH_4)



Plumbane (PbH_4)

6) CHEMICAL PERIODICITY

a. Textbook Errors Summary

THE MEANING OF ELEMENT, Mysels, K. J., J. Chem. Ed., 35, 568 (1958)

Confusion often exists in distinguishing between the terms "element" and "elementary substance".

THE CORRECT SIZES OF THE NOBLE GAS ATOMS, Huheey, James E., J. Chem. Ed., 45, 791 (1968)

Since such important chemical properties as ionization energy and electron affinity are related to the size of atoms, it is quite common to see discussions relating atomic radii to nuclear charge in general chemistry textbooks. Briefly, the argument goes that within a given series nuclear charge increases faster than does shielding, hence the effective nuclear charge increases, resulting in shrinkage with increasing atomic number. Unfortunately, such discussions are often accompanied by a chart or table which illustrates the trend but includes values for the noble gases which are obviously out of line.

b. References

1. The Chemistry of the Elements, Mechamkin, Howard, McGraw-Hill, 259 pp. (1968) - $3.50
2. Distribution of the Elements in Our Planet, Ahrens, Louis H., McGraw-Hill (1967) - $1.95
3. Electronic Structure, Properties and the Periodic Law, Sisler, H. H., Reinhold Book Corp. 128 pp. (1963) - $2.25
4. Man Made Transuranium Elements, Seaborg, Glenn, Prentice-Hall, 120 pp. (1963) - $1.50
5. Periodic Correlations - Physical Inorganic Chemistry Series, Rich, Ronald L., Benjamin 175 pp. (1965) - $4.95
6. The Search for the Elements, Asimov, Isaac, Fawcett, 144 pp. (1966) - $0.60

c. Selected Films

1. Chemical Families - MLA, cat. no. 4112, $165. (16mm, color, sound, 22 min.)
2. Teacher Training Introduction to "Chemical Families" - MLA, cat. no. 4012, $40. (16mm, B/W, sound, 7 min.)
3. Electronegativity - AIM, cat. no. YF-244, $38. (16mm, color, sound, 4 min.)
4. Melting Points - Determination and Trends - AIM, cat. no. YF-224, $86. (16mm, color, sound, 9 min.)

d. Other Teaching Aids

1. Illuminated Periodic Chart: Dutton, F. B., J. Chem. Ed., 28, 110 (1951)

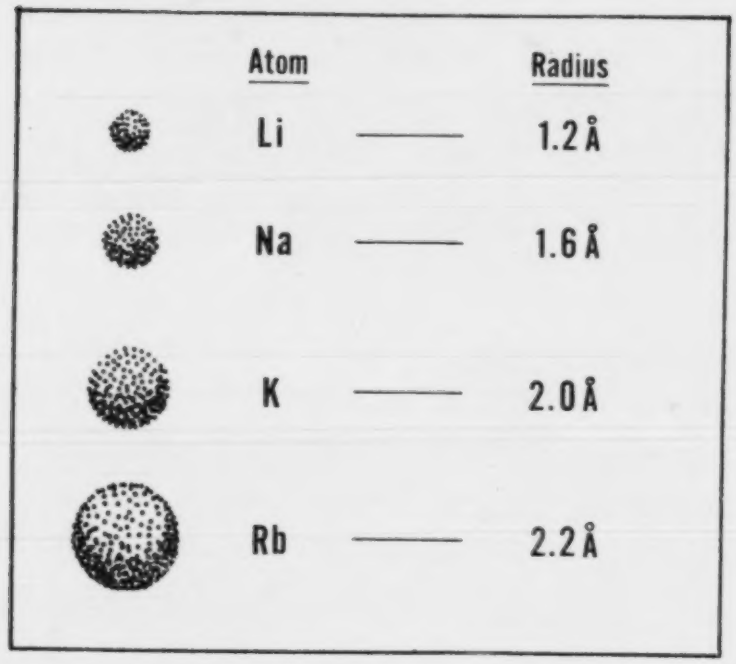
e. Selected Lecture Demonstrations

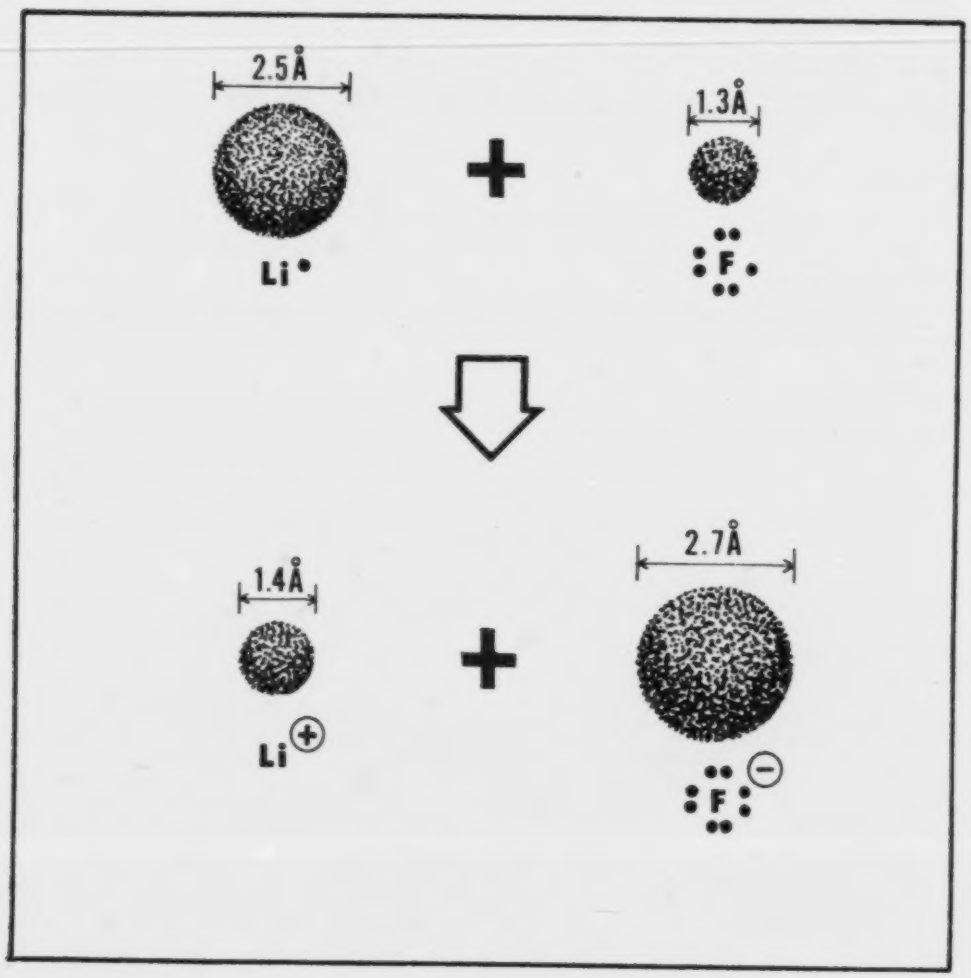
1. See index for references to individual elements in Tested Demonstrations in Chemistry, Alyea and Dutton.

f. Transparency Master

"Relative Sizes"

RELATIVE SIZES





7) STOICHIOMETRY

a. Textbook Errors Summary

GRAM MOLECULAR WEIGHT, Mysels, K. J., J. Chem. Ed., 36, 303 (1959)

Molecular weight is a dimensionless number whereas gram molecular weight denotes an amou material equal to that dimensionless number.

b. References

1. Formulation and Stoichiometry - A Review of Fundamental Chemistry, Margolis, Emil J. Appleton, Century, Crofts, 225 pp. (1968) - $3.50
2. The Mole Concept in Chemistry, Kieffer, W. F., Reinhold Book Corp., 128 pp. (1962) -
3. Stoichiometry, Nash, Leonard K., Addison-Wesley, 182 pp. (1966) $2.95

c. Selected Films

1. Determining a Molecular Formula - MGHT, cat. no. 612008, B/W, $75.; cat. no. 612020, $150. (16mm, sound, 12 1/2 min.)
2. Gases and How They Combine - MLA, cat. no. 4103, $165. (16mm, color, sound, 22 min.)
3. Model for Weight Relations in Chemical Reactions - AIM, cat. no. YF-253, $14. (16mm, silent, 4 min.)
4. On Writing Equations (I) and On Writing Equations (II) - WIL, 8mm, $17.; S-8, $19. (silent, 4 min. each)

d. Other Teaching Aids

none listed

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 6, 54, 71-73
2. Microchemistry Projected, Alyea - demonstration numbers: 95, 213, 214
3. Films + Data

(show film, supply typical data for student calculations)

e.g.,

The Sartorius Balance - WIL, 8mm $17.; S-8 $19. (color, silent, 4 min.)

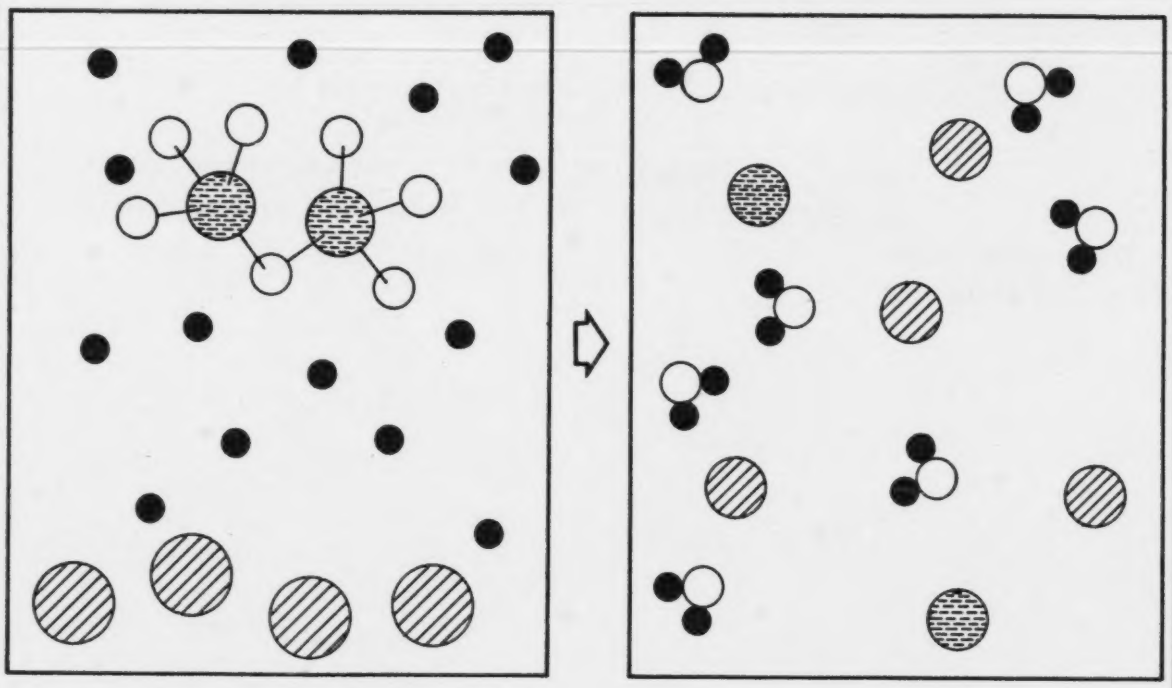
Gravimetric Techniques - HR, $25. (S-8, color, silent, 4 min.)

f. Transparency Master

"Stoichiometry"

STOICHIOMETRY

$Zn + Cr_2O_7^{2-}$



$$4\,Zn + Cr_2O_7^{2-} + 14\,H^+ \longrightarrow 4\,Zn^{2+} + 2\,Cr^{2+} + 7\,H_2O$$

8) MOLECULAR GEOMETRY

a. Textbook Errors Summary

DIPOLE MOMENTS OF SYMMETRICAL ORGANIC MOLECULES, Moulton, W. N., J. Chem. Ed., 38, 522 (1961)

Some classes of compounds, such as symmetrical trans-olefins and para-disubstituted benzenes are said to have a zero dipole moment by symmetry. If the attached groups themselves are sufficiently unsymmetrical, the molecule need not possess a center of symmetry, and hence, may have a finite dipole moment. See also Donohue, J. and D. A. Dows, 39, 480 (1962).

LE BEL AND TETRAHEDRAL CARBON, Sementsov, A., Am. Sci., 43, 97 (1955)

Many textbooks credit Le Bel (along with van't Hoff) with originating the tetrahedral theory while in fact both introduced the concept of the unsymmetrical carbon atom, but Le Bel for a long time opposed the tetrahedral model and even tried to disprove it experimentally.

ON HYDROGEN BONDS, Donohue, J., J. Chem. Ed., 40, 598 (1963)

In discussing hydrogen bonding, geometric restrictions on the bond angles and the steric effect of the hydrogen are often neglected. This may lead the student to incorrect conclusions about the structure of compounds.

b. References

1. Chemical Bonding and the Geometry of Molecules, Ryschkewitsch, G. E., Reinhold Book Corp. 128 pp. (1963) - $2.25
2. Molecular Structure, Jennings, K. R., Barnes and Noble, 136 pp. (1969) - $1.75
3. Physical Methods for Determining Molecular Geometry, Brey, Wallace S., Jr., Reinhold Book Corp., 128 pp. (1965) - $2.25
4. The Shape of Carbon Compounds, Herz, Werner, Benjamin, 164 pp. (1963) - $2.45
5. Structure of Small Molecules, Orville-Thomas, W. J., American Elsevier, 198 pp. (1966) - $5.00

c. Selected Films

1. Shapes and Polarities of Molecules - MLA, cat. no. 4154, $135. (16mm, color, sound, 18 min.)
2. The Structure of a Covalent Molecule - CCl_4 - LGC, cat. no. E/66A, $9. (8mm, color, silent, 3 min.)
3. The Structure of Water - MGHT, cat. no. 612024, $120. (16mm, color, sound, 14 min.)

d. Other Teaching Aids

1. Models (see also Topic 5)

Construction and Use of Atomic and Molecular Models, Bassow, H., Pergamon, 213 pp. (1968) $5.50

Inexpensive Space-Filling Display Models, Kellett, J. C. and A. N. Martin, J. Chem. Ed., 43, 374 (1966)

Paper Stereo Models, Larson, G. O., J. Chem. Ed., 42, 274 (1965)

e. Selected Lecture Demonstrations

1. Polarities

Materials: 8 small petri dishes; 10-15 ml each of water, methanol, chloroform, carbon tetrachloride; few mg of iodine crystals, few mg of potassium dichromate, 2 spatulas, 8 small stirring rods, models representing H_2O, CH_3OH, $CHCl_3$, CCl_4, I_2, $K_2Cr_2O_7$ (ions), overhead projector, acetate, marking pen.

Procedure: Mark formulas of the four solvents on acetate on overhead projector; set petri dishes of solvents on top of formulas. Show and discuss models, including I_2. Add I_2 to each. Repeat with fresh solvents and $K_2Cr_2O_7$.

2. Relative Boiling Ranges

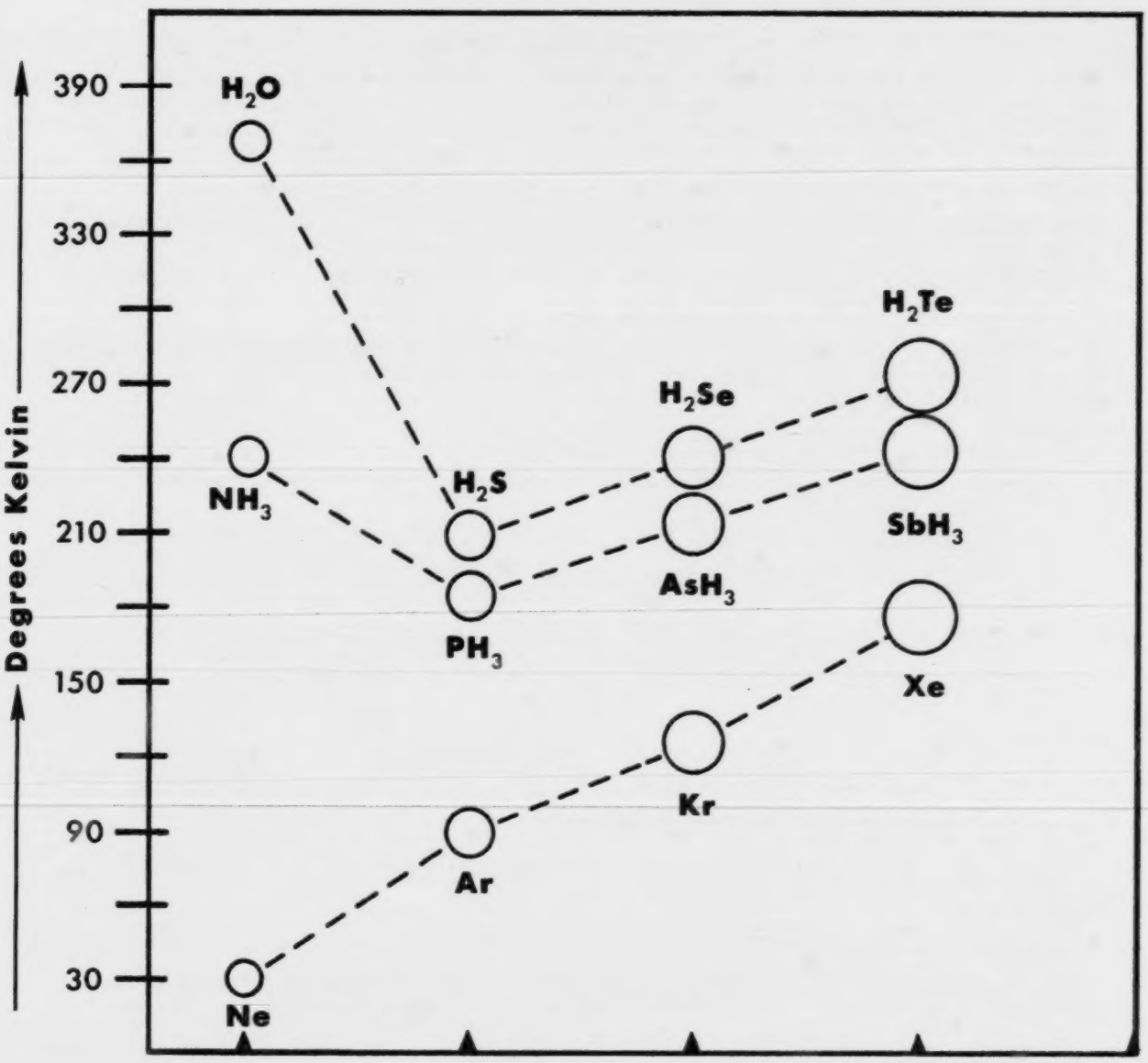
Materials: Large shallow petri dish of hot water; 3-50 ml beakers (each containing 2 "boiling chips"); 3 ml each pentane, diethyl ether (CAUTION), 1-butanol; models of the compounds used; overhead projector, acetate, pen.

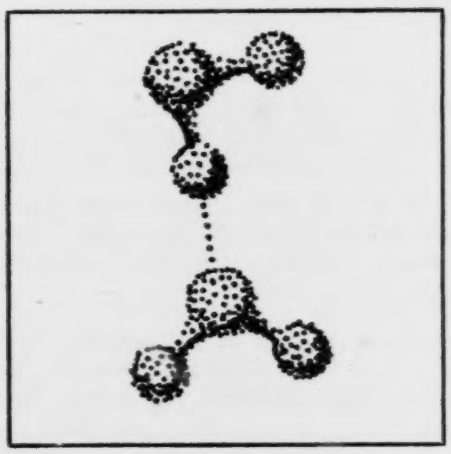
Procedure: Write the formulas of the compounds at positions on the overhead projector acetate and set the dish of hot water, containing the three beakers, on top of this so that each beaker is place near a formula. Show and discuss models and have students predict relative boiling ranges. Add 3 ml 1-butanol to one beaker, then 3 ml ether to another, then 3 ml pentane - in rapid succession. Observe boiling.

f. Transparency Master

"Effects of Hydrogen-Bonding"

EFFECTS OF HYDROGEN-BONDING





Two H_2O molecules

9) GASES: REAL AND IDEAL

a. Textbook Errors Summary

KINETIC ENERGIES OF GAS MOLECULES, Aherne, J. C., J. Chem. Ed., 42, 655 (1965)

Some texts show kinetic energy distributions of gas molecules with points of inflection on both sides of the maximum in the curve. There should be no inflection on the low energy side of the maximum.

KINETIC THEORY, TEMPERATURE, AND EQUILIBRIUM, Carpenter, D. K., J. Chem. Ed., 43, 332 (1966)

Several texts maintain that an essential postulate of the kinetic theory of gases is that the mean molecular kinetic energy is proportional to the absolute temperature. This statement is valid as a conclusion of the molecular kinetics but is not necessary as a postulate.

WORK OF COMPRESSING AN IDEAL GAS, Bauman, R. P., J. Chem. Ed., 41, 102 (1964)

Perfect gas compression problems often contain no explicit statement of reversibility. This leaves the student uncertain how to calculate the work done by the gas. Since work is not a state function, the exact path must be specified by which the process occurs in order to calculate the work.

THE SOLUBILITY OF GASES IN LIQUIDS, Mysels, K. J., J. Chem. Ed., 32, 399 (1955)

It is usually thought that increasing the temperature decreases the solubility of a gas in a liquid. This has been found to be untrue in a number of systems.

CHEMICAL POTENTIALS IN AN IDEAL MIXTURE OF IDEAL GASES, Robinson, P. J., J. Chem. Ed., 41, (1964)

In a common derivation of the chemical potential for an ideal gas mixture two errors in differentiation cancel and lead to the correct result.

b. References

1. The Gaseous State, Parsonage, N. G., Pergamon, 170 pp. (1966) - $3.25
2. Thermal Properties of Matter I: Kinetic Theory of Gases, Kauzmann, Walter, Benjamin, 262 pp. (1966) - $3.95
3. Quest for Absolute Zero - Mendelsson, K., McGraw-Hill, 256 pp. (1967) - $2.45

c. Selected Films

1. Behavior of Gases - MLA, cat. no. 0115, $90. (16mm, B/W, sound, 15 min.)
2. Gas Laws and Their Applications - EBF, cat. no. 779, $86. (16mm, B/W, sound, 13 min.)
3. Kinetic Theory (6 film set) - HR, cat. no. 89-2810, $150. for 6 films (S-8, color, silent, each film 4 min.)
4. Molecular Motion - HR, $25. (S-8, color, silent, 4 min.)
5. Absolute Zero - MLA, cat. no. 4001, $18.50 (S-8, B/W, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projection Transparencies - MLA ($1.50 each)

   cat. no. 0909 - Elastic Collision

   cat. no. 0910 - Inelastic Collision

   cat. no. 0911 - Momentum in Inelastic Collision

   cat. no. 0916 - Kinetic Theory of Gases

2. Molecular Motion Demonstrator (for overhead projection)

   Educational Materials and Equipment Company $49.
   Box 63
   Bronxville, N. Y. 10708

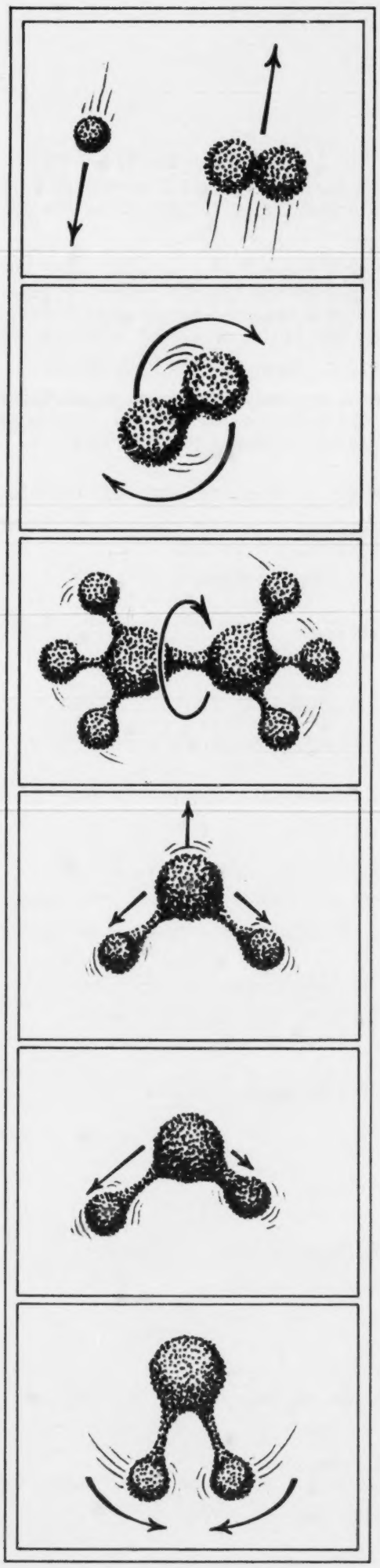
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 63, 65, 156, 160.
2. Mechanical Gas Model - $11. - REC, cat. no. 30470
3. Elasticity of Gases Apparatus - $3. - REC, cat. no. 30220
   (can be used with "ideal" or non-ideal (e.g., NH_3 vapor or H_2O vapor) gases)
4. Specific Heat of Gas Apparatus - $15. - REC, cat. no. 4700

f. Transparency Master

"Particles in Motion"

PARTICLES IN MOTION



Translation

Simple Rotation

Internal Rotation

Symmetric Vibration

Asymmetric Vibration

Bending Vibration

10) SOLIDS

a. Textbook Errors Summary

FLOW OF GLASS UNDER ITS OWN WEIGHT, Dingledy, David, J. Chem. Ed., 39, 84 (1962)

Glass does not flow measurably at room temperature as a viscous liquid under stress but does accept a non-permanent deformation, returning to its original shape slowly after the stress is removed. This deformation may be mistaken for viscous flow.

b. References

1. Chemistry of Solids, Galwey, A. K., Barnes and Noble, 210 pp. (1967) - $5.00
2. Solid State Chemistry, Hannay, N. Bruce, Prentice-Hall, 192 pp. (1967) - $4.95
3. Seven Solid States: An Introduction to the Chemistry and Physics of Solids, Moore, W. J., Benjamin, 224 pp. (1967) - $3.95

c. Selected Films

1. Thermal Expansion of Solids - EAL, cat. no. 80-3296, $23. (S-8, color, silent, 4 min.)
2. Most Solids Melt - ICF, cat. no. 13015, $20. (S-8, color, silent, 4 min.)
3. Identifying Solids by Density - HR, cat. no. 80-3262, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Send for booklet describing construction of many types of models:

"Atomic, Molecular, and Crystal Models"

Edmund Scientific Co., Barrington, New Jersey 08007

cat. no. 9076, 50 cents

e. Selected Lecture Demonstrations

1. Cleavage of Crystals vs. Amorphous Solids

Materials: Several large crystals of rock salt and rock candy, regular and irregular pieces of thick plexiglas, small cutting board, lump of modeling clay, sharp paring knife, small hammer, overhead projector. Styrofoam models.

Procedure: Display crystals and plexiglas pieces on stage of overhead projector. Cleave crystals and plexiglas pieces (imbedded in clay on cutting board). Show possibilities of planar cleavage of crystals and irregular fracture of plexiglas. Show styrofoam models of crystalline and amorphous solids to explain cleavage behavior.

2. Melting Behavior of Crystals vs. Amorphous Solids

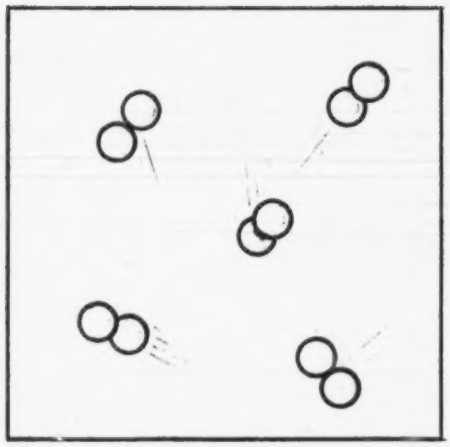
Materials: Crystals of phenylacetic acid, small pieces of paraffin, large petri dish, hot (80-90°) water, 2 - 50 ml beakers, overhead projector. Styrofoam models.

Procedure: Set beakers in large petri dish on overhead projector. Place a few crystals of phenylacetic acid in one beaker and a few pieces of paraffin in the other. Pour hot (80-90°) water into petri dish. Observe sharp melting range of phenylacetic acid and broad softening range of paraffin. Remove beakers from hot water, remove petri dish, set beakers on overhead projector and observe differences in solidification behavior. Show models.

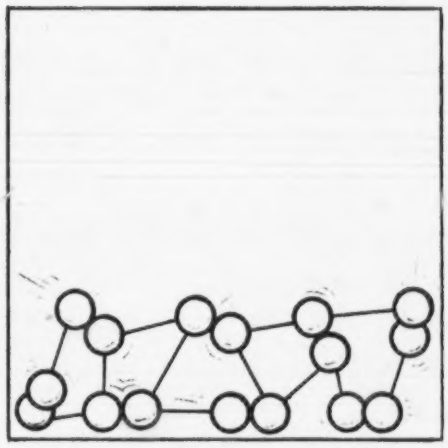
f. Transparency Master:

"Order and Motion"

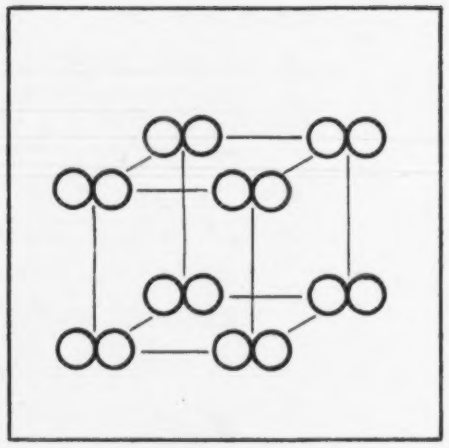
ORDER AND MOTION



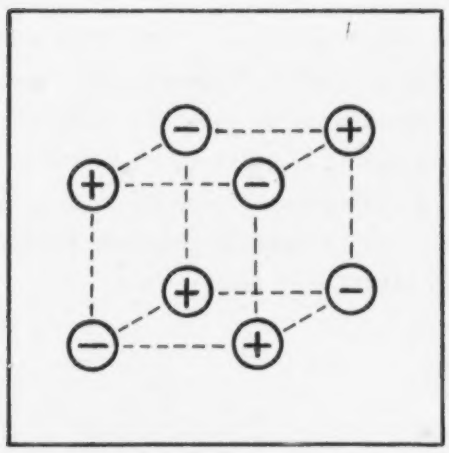
Gas
- little order
- rapid motions



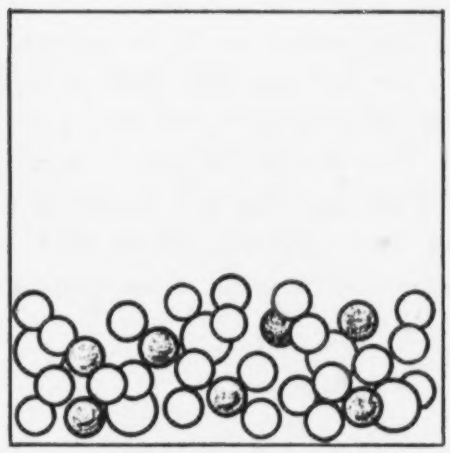
Liquid
- more ordered
- slower motions



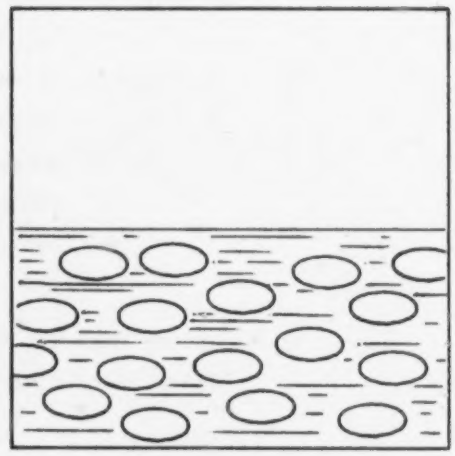
Crystalline solid
- highly ordered
- little motion



Ionic crystal



Amorphous solid



Liquid crystal

11) CRYSTAL STRUCTURE

a. Textbook Errors Summary

THE CLASSIFICATION OF CRYSTALS, Mysels, K. J., J. Chem. Ed., 34, 40 (1957)

The classification of crystals into crystal systems on the basis of the length and direction of the crystal axes can lead to errors. The symmetry of the crystal in all of its properties must confirm a correct classification.

THE LUBRICATION PROPERTIES OF GRAPHITE, Lavrakas, J. Chem. Ed., 34, 240 (1957)

The low friction and wear of graphite surfaces are due to the presence of adsorbed gases or vapors and not to the laminar structure of graphite.

b. References

1. Crystals and Crystal Growing, Holden, Alan and Phylis Singer, Doubleday, 320 pp. (1960) $1.75
2. In Introduction to Crystal Chemistry, Evans, R. C., Cambridge, 410 pp. (1964) - $2.95
3. Electronic Processes in Ionic Crystals, Mott, N. F. and R. W. Gurney, Dover, 272 pp. (1964) $2.25
4. Introduction to Crystallography, Sands, D. E., Benjamin, 192 pp. (1969) - Approx. $3.95

c. Selected Films

1. Crystals - MLA, cat. no. 0114, $135. (16mm, color, sound, 25 min.)
2. Krystallos - STER, free loan (16mm, color, sound, 11 min.)
3. Close-Packing of Spheres - HR, cat. no. 04-96331, $25. (S-8, color, silent, 4 min.)
4. Crystal Growth - HR, cat. no. 04-96299, $25. (S-8, color, silent, 4 min.)
5. Bubble Model of A Crystal: Structure and Boundaries - EAL, cat. no. 84-0116, $25. (S-8, B/W, silent, 2 min.)
6. Bubble Model of A Crystal: Deformation and Dislocations - EAL, cat. no. 84-0124, $25. (S-8, B/W, silent, 3 min.)
7. Crystals and X-Ray Diffraction - MLA, cat. no. 4006, $21. (S-8, B/W, silent, 4 min.)

d. Other Teaching Aids

Send for booklet describing construction of many types of models:

"Atomic, Molecular, and Crystal Models"
Edmund Scientific Co., Barrington, New Jersey 08007
cat. no. 9076, 50 cents

e. Selected Lecture Demonstrations

Closest-Packing Arrangements

Materials: About 50 spherical balloons in each of three different colors (~150 total), roll of double-surface scotch tape, overhead projector, acetate, marking pens to match balloon colors.

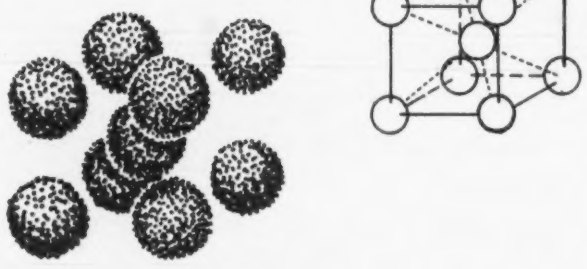
Procedure: Draw staggered rows of large circles (~2" diameter) on acetate on overhead projector. Print a in center of each circle in one color. Label b and c positions in other colors (at alternate rows of staggered "vacant" positions). Build a layer of one color balloons in 4 staggered rows of fours (16 balloons), connecting balloons with small pieces of double-surface tape. Make four such "planes" of balloons in three different colors, having two sets alike (same color as a on acetate). Show that these layers could be most efficiently stacked in aba or abca patterns. Display previously prepared balloon models of hexagonal closest-packed, cubic closest-packed, and body-centered cubic unit cell models (using balloons of appropriate a, b, c colors). Discuss: Metals having such unit cell patterns, assignment of particles to "within" cell boundaries, relative density considerations, holes in packing arrays as possible sites for small ions in crystalline salts. (See Film #3 in "Selected Films" above.)

f. Transparency Master

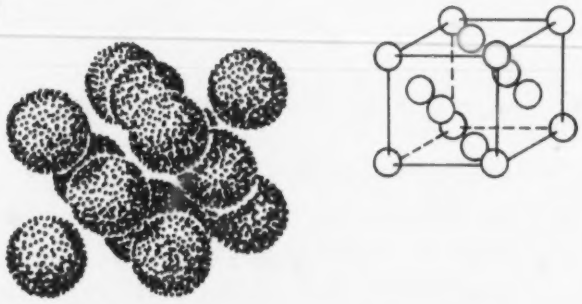
"Three Simple Unit Cells"

THREE SIMPLE UNIT CELLS

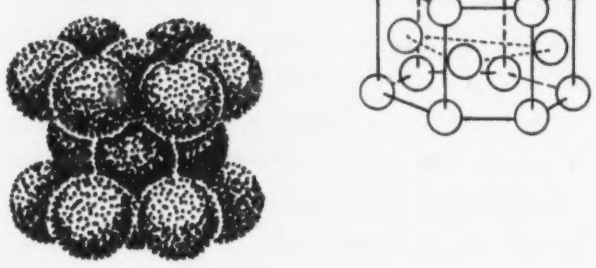
Body-centered Cubic



Cubic Closest-packed
(Face-centered Cubic)



Hexagonal Closest-packed



12) CHANGE OF STATE

a. Textbook Errors Summary

TERNARY DIAGRAMS, Mysels, K. J., J. Chem. Ed., 38, 627 (1961)

Three-phase regions on ternary diagrams are frequently mislabeled as two-phase regions.

EUTECTICS, Copley, G. N., J. Chem. Ed., 36, 596 (1959)

Eutectics are often erroneously represented as separate phases on phase diagrams whereas in fact they are always two phase mixtures.

THE CHANGE OF VAPOR PRESSURE WITH TEMPERATURE, Mysels, K. J., J. Chem. Ed., 35, 568 (1958)

In discussing the change of vapor pressure with temperature, the effects of the molar volume of the liquid and the total external pressure often are ignored.

THE TRIPLE POINT OF WATER, Swinton, F. L., J. Chem. Ed., 44, 541 (1967)

The triple point of water has now been chosen as the basic fixed point on both Practical and Thermodynamic Scales as 273.16° Kelvin (or +0.01° Celsius).

b. References

1. Gases, Liquids, and Solids, Tabor, D., Penguin Books, Inc., 294 pp. (1969) - $2.95

c. Selected Films

1. Explaining Matter: Molecules in Motion - EBF, cat. no. 1675, $135. (16mm, color, sound, 11 min.)
2. Phase Change (Change of State) - EBF, cat. no. S80601, $22. (S-8, color, silent, 4 min.)
3. Molecular Motion in Condensed Phases - MLA, cat. no. 4010, $21. (S-8, color, silent, 4 min.)
4. Critical Temperature - HR, cat. no. 80-2058, $25. (S-8, color, silent, 4 min.)
5. Boiling Point and Pressure - HR, cat. no. 80-3403, $25. (S-8, color, silent, 4 min.)
6. A Model of the Kinetic-Molecular Concept - WIL, $19. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Molecular Motion Demonstrator (for overhead projection)

Educational Materials and Equipment Company $49.
Box 63
Bronxville, N. Y. 10708

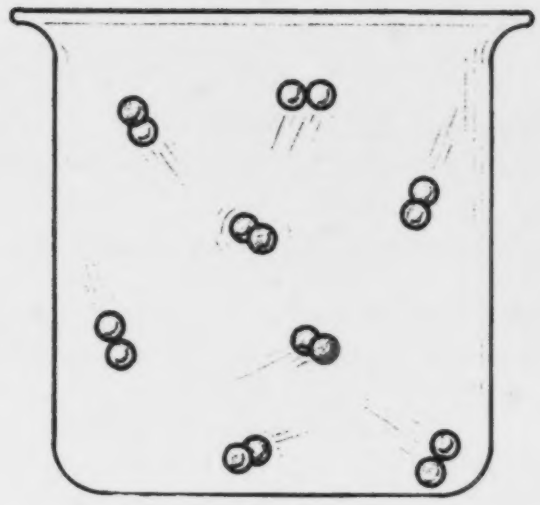
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 151, 180, 181.

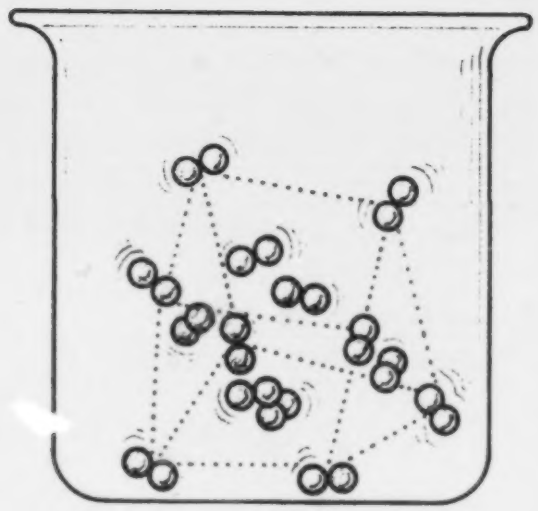
f. Transparency Master

"Solid, Liquid, and Gas"

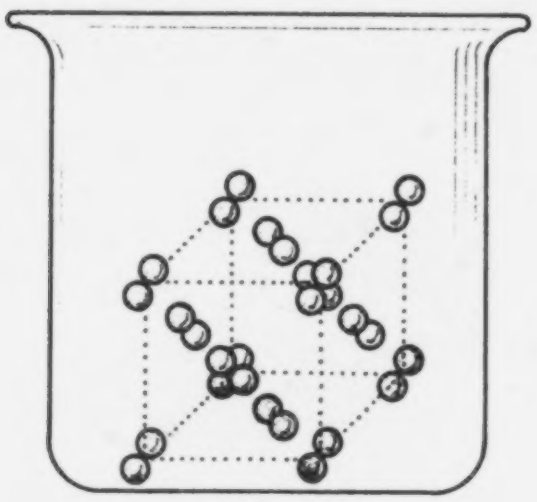
SOLID, LIQUID, AND GAS



HEAT



HEAT



13) LIQUIDS

a. Textbook Errors Summary

THE DIFFERENCE BETWEEN C_p AND C_v FOR LIQUIDS AND SOLIDS, Smith, N. O., J. Chem. Ed., 42, 654 (1965)

The difference between C_p and C_v for condensed phases is usually dismissed as negligible. In some cases this is not true, for example in CS_2, C_p is 35% larger than C_v.

b. References

1. Kinetic Theory of Liquids, Frenkel, L., Dover, 499 pp. (1955) - $3.00
2. Nonaqueous Solvents, Zingaro, Ralph A., Raytheon Education Co., 128 pp. (1968) - $2.50
3. The Structure and Properties of Water, Eisenberg, D. and W. Kauzmann, Oxford, 300 pp. (1969) $4.50
4. Liquids and Solutions, Dreisbach, Dale, Houghton-Mifflin, 208 pp. (1966) - $2.95

c. Selected Films

1. Identifying Liquids by Density - HR, cat. no. 80-3270, $25. (S-8, color, silent, 4 min.)
2. Thermal Expansion of Liquids - HR, cat. no. 80-3304, $25. (S-8, color, silent, 4 min.)
3. Liquids Evaporate - ICF, cat. no. 13025, $20. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Molecular Motion Demonstrator (for overhead projection)

Educational Materials and Equipment Company $49.
Box 63
Bronxville, N. Y. 10708

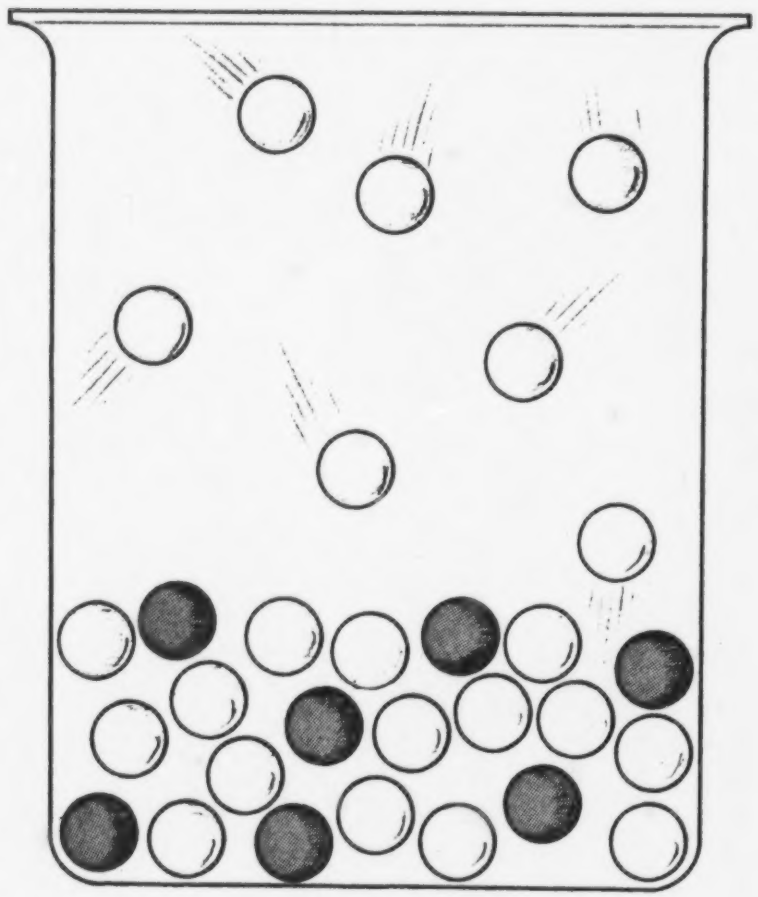
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 66-68, 143, 189.
2. Micro-Chemistry Projected (TOPS), Alyea, H. N. (order from TOPS, Alyea, 337 Harrison Street, Princeton, N. J. - 08540, $4.) - Demonstration Numbers: 97-100, 130, 131, 193-204.

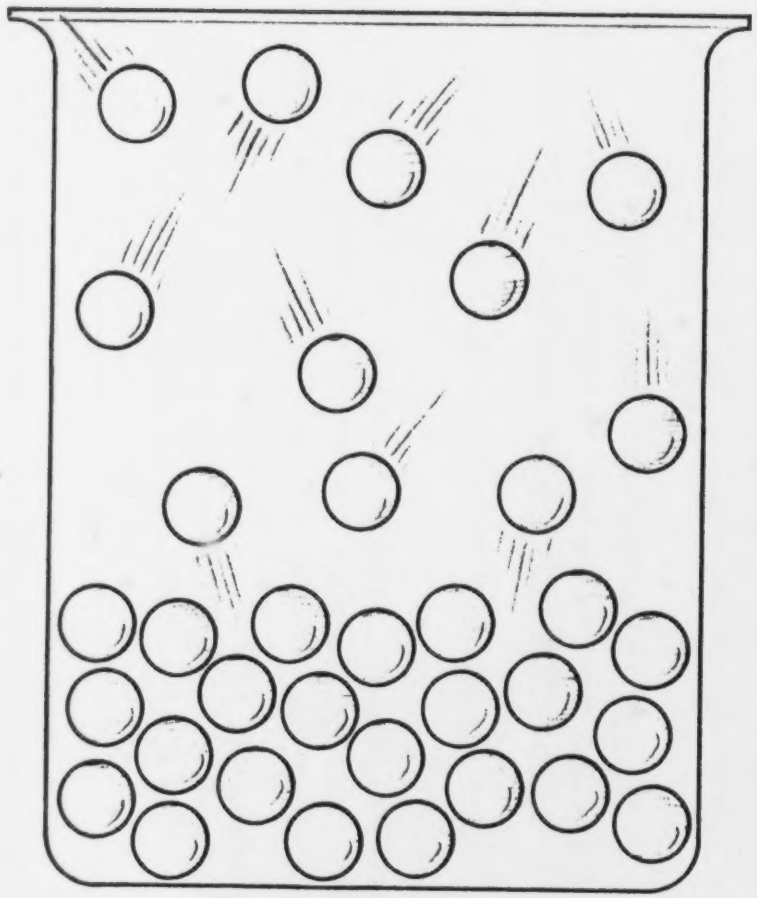
f. Transparency Master

"Vapor Pressure"

VAPOR PRESSURE



SOLUTION



PURE LIQUID

14) AQUEOUS SOLUTIONS

a. Textbook Errors Summary

THE MEANING OF MOLE FRACTION, Bijvoet, J. M. and A. F. Peerdeman, J. Chem. Ed., 35, 240 (1958)

The mole fraction of a solute is a function of the molecular weight of the solvent; however, this molecular weight need never be that of the associating liquid but is either arbitrary or has to be that of the vapor phase.

THE MECHANISM OF VAPOR PRESSURE LOWERING, Mysels, K. J., J. Chem. Ed., 32, 179 (1955)

Restriction of the rate of evaporation by solvent molecules in the surface of a solution has been used to explain Raoult's Law. This explanation is shown to be incorrect.

b. References

1. Chemical Solutions, Welcher, Frank, Van Nostrand, 404 pp. (1966) - $4.95
2. Metal Ions in Aqueous Solution, Hunt, John P., Benjamin, 136 pp. (1963) - $4.95
3. Ionic Processes in Solution, Gurney, Ronald W., Dover, 284 pp. (1962) - $1.85
4. The Solubility of Nonelectrolytes, Hildebrand, Joel H. and Robert L. Scott, Dover, 462 pp. (1964) - $3.00

c. Selected Films

1. Solutions - CORF, $180. (16mm, color, sound, 16 min.)
2. Dynamics of Solution - MGHT, cat. no. 612017, $170. (16mm, color, sound, 14 min.)
3. Liquids in Solution - MGHT, cat. no. 612014, $160. (16mm, color, sound, 11 min.)

d. Other Teaching Aids

None listed

e. Selected Lecture Demonstrations

1. Solubility, Solution Rate, and Particle Size

Materials: Large crystals, small crystals, fine powder of $CuSO_4 \cdot 5H_2O$; triple-beam balance; 3 petri dishes, distilled water; 16 styrofoam models of simple cubic unit cells; double-surface tape; overhead projector; quantitative solubility data.

Procedure: Place water in petri dishes on overhead projector. Weigh large crystal, then weigh same amounts of small crystals and powder. Place solids in dishes of water and observe rate of color formation as solid dissolves. Stack 16 unit cells in large cubic pattern (using pieces of double-surface tape); count spheres at surface. Break model up into 8 smaller cubes and count surface spheres. Finally, break up into 16 "unit cells" and count surface spheres. Discuss surface area and rate of dissolving. Display previously obtained quantitative data on concentrations of saturated solutions from large crystals, small crystals, and powder and discuss.

2. Colligative Properties

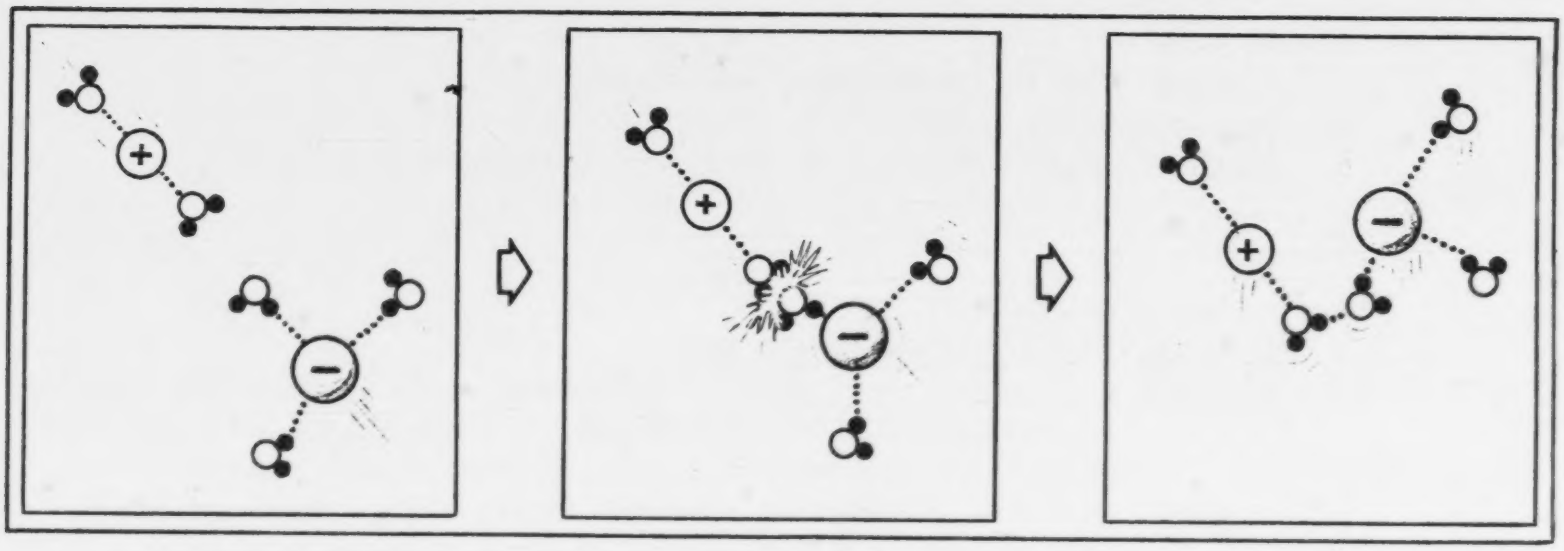
a. Freezing Point Depression - see: Pinkus, A. G. and B. G. Barron, J. Chem. Ed., 33, 138 (1956)

b. Osmotic Pressure - see: Harris, E. T., J. Chem. Ed., 12, 395 (1935)

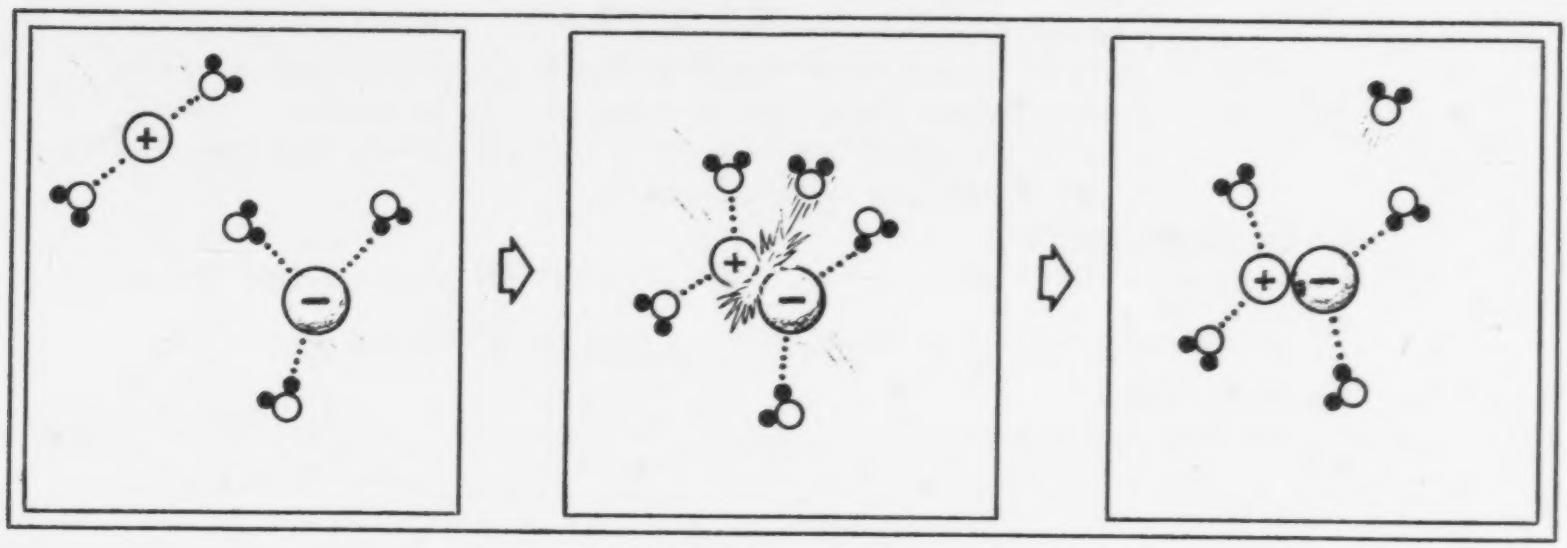
f. Transparency Master

"Ion Collisions in Solution"

ION COLLISIONS
in solution



Ineffective collision



Effective collision

15) SOLUBILITY EQUILIBRIA

a. Textbook Errors Summary

THE SOLUBILITY PRODUCT CONSTANTS OF THE METALLIC SULFIDES, Waggoner, W. H., J. Chem. Ed., 35, 339 (1958)

Indirect methods for determination of solubility product constants are discussed. The thermodynamic method is cited as an often neglected but highly reliable method for determining solubility products. Solubility product data for metallic sulfides are cited as often being unreliable.

THE SOLUBILITY OF ACETATES, Mysels, K. J., J. Chem. Ed., 35, 32 (1958)

Acetate salts, thought always to be soluble in water, show many instances of low solubility.

b. References

1. Introduction to Solution Equilibrium, Guyon, John C. and Berwyn E. Jones, Allyn and Bacon, Inc., 165 pp. (1968) - $3.25
2. Equilibrium: A Chemistry of Solutions, Blackburn, T., Holt, Rinehart and Winston, 240 pp. (1969) - $6.50

c. Selected Films

1. Solubility Product - AIM, $67. (16mm, color, sound, 7 min.)
2. Cation Analysis - Wet Chemical Methods - HR, cat. no. 04-96398 (reel - 04-96406), $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

None listed

e. Selected Lecture Demonstrations

1. Alternative Routes to Saturation

Materials: 0.50 M $SrCl_2$, 0.50 M Na_2CrO_4, 0.50 M NaCl, powdered $SrCrO_4$, 100 ml "tall-form" beakers, overhead projector, 2 magnetic stirrers, 2 filtration set-ups, Spectronic-20 (or equivalent) cuvettes.

Procedure: At beginning of lecture, set 2 beakers on overhead projector. In one, place 50 ml 0.50 M NaCl, then add powdered $SrCrO_4$. In other, place 25 ml 0.50 M $SrCl_2$ and 25 ml 0.50 M Na_2CrO_4. Observe, then transfer beakers to stirring set-ups and stir for about 30 minutes. Filter both solutions and compare color intensities of filtrates qualitatively in beakers on overhead projector and quantitatively with Spectronic-20. Discuss reason for using the 0.50 M NaCl "solvent" for comparison rather than pure water.

2. Le Chatelier's Principle

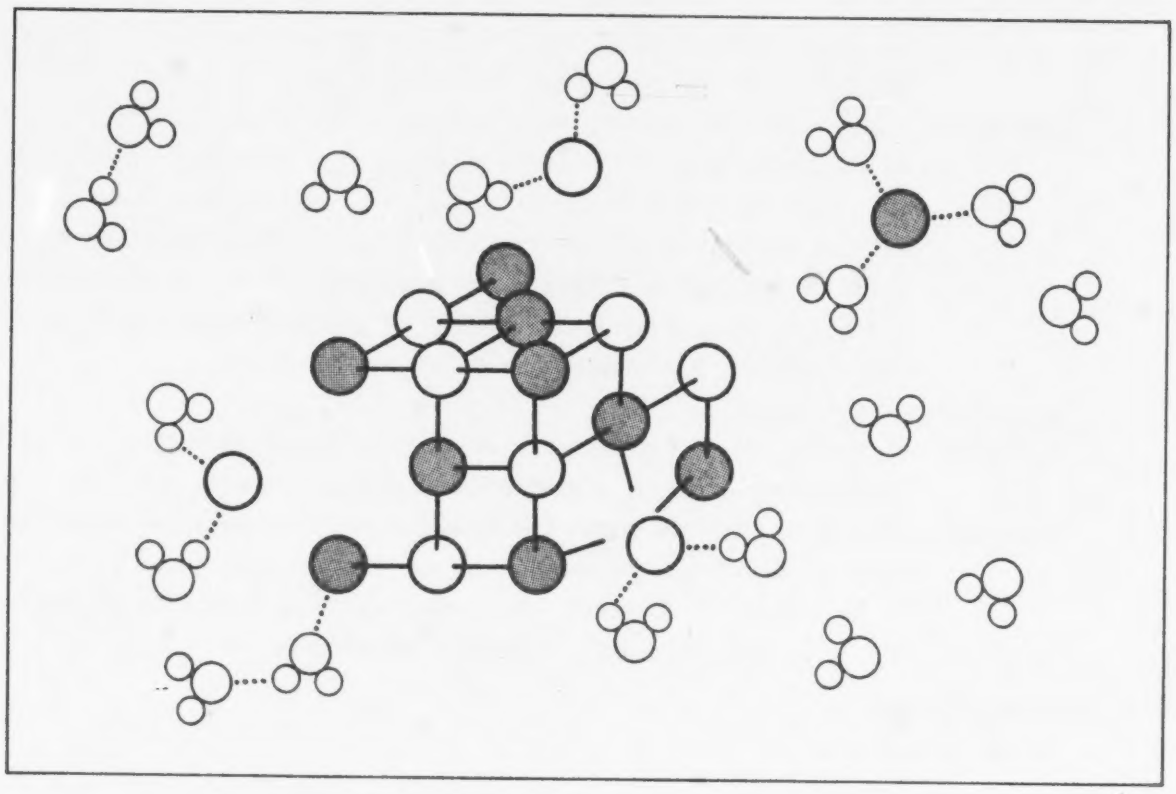
Materials: Saturated $SrCrO_4$ (in contact with solid), saturated Na_2CrO_4, saturated $SrCl_2$, 50 ml beakers, overhead projector, filtration set-up, stirring rods.

Procedure: Display on overhead projector beaker containing saturated $SrCrO_4$ in contact with solid $SrCrO_4$. Filter and divide filtrate into three parts. Display three beakers of filtrate. To first, add 10 ml saturated Na_2CrO_4. To second, add 10 ml saturated $SrCl_2$. Compare and discuss.

f. Transparency Master

"Saturated Solution"

SATURATED SOLUTION



Rate of escape from crystal equals the rate of return to crystal.

16) COLLOIDS

a. Textbook Errors Summary

THE ORIGINAL OBSERVATIONS OF BROWNIAN MOTION, Layton, David, J. Chem. Ed., 42, 367 (1965)

Brown did not observe the motion of pollen grains in suspension. The particles for which the motion was observed were from within the pollen grains, probably cytoplasmic granules.

BROWNIAN MOTION AND THE STABILITY OF COLLOIDS, Mysels, K. J., J. Chem. Ed., 32, 319 (1955)

Brownian motion can account for the stability of only the smallest collodial dispersions. For larger particle sizes, thermal convection currents and slow rates of sedimentation are controlling factors.

b. References

1. Surface and Colloid Chemistry, Parfitt, G. D., Pergamon, 170 pp. (1966) - $2.95
2. Colloid Chemistry, Vold, M. J. and R. D. Vold, Reinhold Book Corp., 128 pp. (1964) - $2.25
3. Investigations on the Theory of the Brownian Movement, Einstein, Albert, Dover, 132 pp. (1956) - $1.50

c. Selected Films

1. Colloids - EBF, cat. no. 201, $70 (16mm, B/W, sound, 11 min.)
2. The Colloidal State - CORF, $180 (16mm, color, sound, 16 min.)
3. Brownian Motion - ICF, cat. no. 13225, $19. (S-8, color, silent, 3 min.)

d. Other Teaching Aids

"Relevance":

Take 35mm slides of industrial smoke, automobile exhaust, foam on polluted water supplies, etc.

Discuss roles of colloids in environmental pollution and aspects of colloid chemistry now available as possible solutions to some environmental problems.

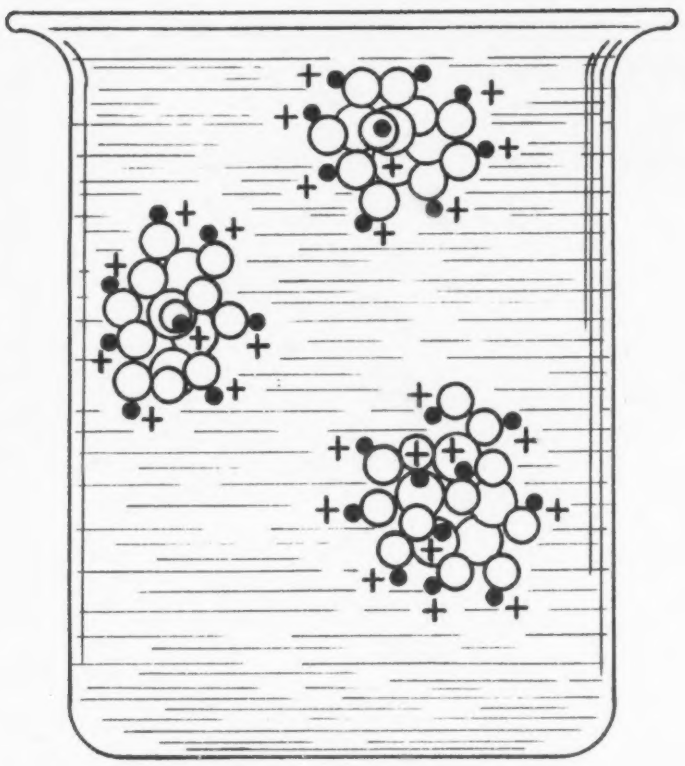
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 49-50, 148, 157, 169, 206.

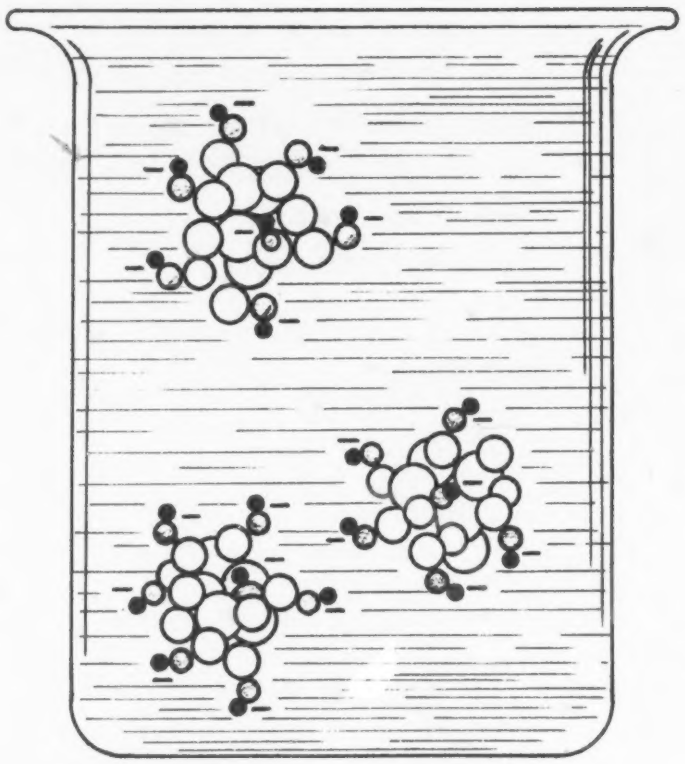
f. Transparency Master

"Stabilized Sols"

STABILIZED SOLS



IRON (III) OXIDE SOL
(Stabilized by adsorbed cations)



ARSENIC (III) SULFIDE SOL
(Stabilized by adsorbed anions)

17) CHEMICAL THERMODYNAMICS

a. Textbook Errors Summary

REVERSIBLE WORK, Christian, S. D., J. Chem. Ed., 42, 547 (1965)

Only for isothermal processes is reversible work always greater than irreversible work. The restriction of constant temperature is often ignored.

THE BEHAVIOR OF PARTIAL MOLAR QUANTITIES AT HIGH DILUTION, Garrod, J. E. and Thelma M. Harrington, J. Chem. Ed., 46, 165 (1969)

In some texts and laboratory manuals the student is instructed to "plot the integral heat of solution of potassium nitrate against molality and extrapolate to m = 0, to obtain the integral heat of solution at infinite dilution. The slope of the curve should be zero at m = 0". In fact the slope will be positively infinite at m = 0!

DEVIATIONS FROM RAOULT'S LAW, McGlashan, M. L., J. Chem. Ed., 40, 516 (1963)

It is frequently assumed that deviations from Raoult's Law must be always either positive or negative for a binary mixture. There is no thermodynamic restriction of this sort and examples where deviations change sign are known.

RAOULT'S LAW AND THE THERMODYNAMIC DEFINITION OF IDEAL MIXING, Williamson, A. G., J. Chem. Ed., 43, 211 (1966)

Raoult's Law and the thermodynamic definition of ideal mixing are usually said to be equivalent if the vapors behave as ideal gases. This is shown to be untrue, the error arising from neglect of the effect of pressure on the chemical potential of the liquid phase.

b. References

1. Understanding Chemical Thermodynamics, Pimentel, George C. and Richard D. Spratley, Holden-Day, Inc. 227 pp. (1969) - $3.95
2. Basic Chemical Thermodynamics, Waser, Jurg, Benjamin, 296 pp. (1966) - $3.95
3. The Second Law: An Introduction to Classical and Statistical Thermodynamics, Bent, Henry A., Oxford, 442 pp. (1965) - $3.75
4. Problems in Chemical Thermodynamics, Bearman, Richard J. and Benjamin Chu, Addison-Wesley, 240 pp. (1967) - $4.95

c. Selected Films

1. Energy Conversion - HR, cat. no. 80-3437, $25. (S-8, color, silent, 4 min.)
2. The Bomb Calorimeter - AIM, cat. no. YF-223, $86. (16mm, color, sound, 9 min.)
3. Carnot Cycle - MGHT, cat. no. 626509, $60. (16mm, B/W, sound, 8 min.)
4. Heat of Fusion, HR, cat. no. 80-3429, $25. (S-8, color, silent, 4 min.)
5. Energy Cycles - WIL, $19. (S-8, color, silent, 4 min.)
6. Molecules in Motion - ROB, $180 (16mm, B/W, sound, 30 min.)
7. Molecules at Work - ROB, $180. (16mm, B/W, sound, 30 min.)
8. The Second Law - ROB, $180. (16mm, B/W, sound, 30 min.)
9. Entropy - ROB, $180. (16mm, B/W, sound, 30 min.)

d. Other Teaching Aids

1. Thermodynamics: An Auto-Instructional Text, Mark, M., Prentice-Hall, 160 pp. (1967) - $3.95

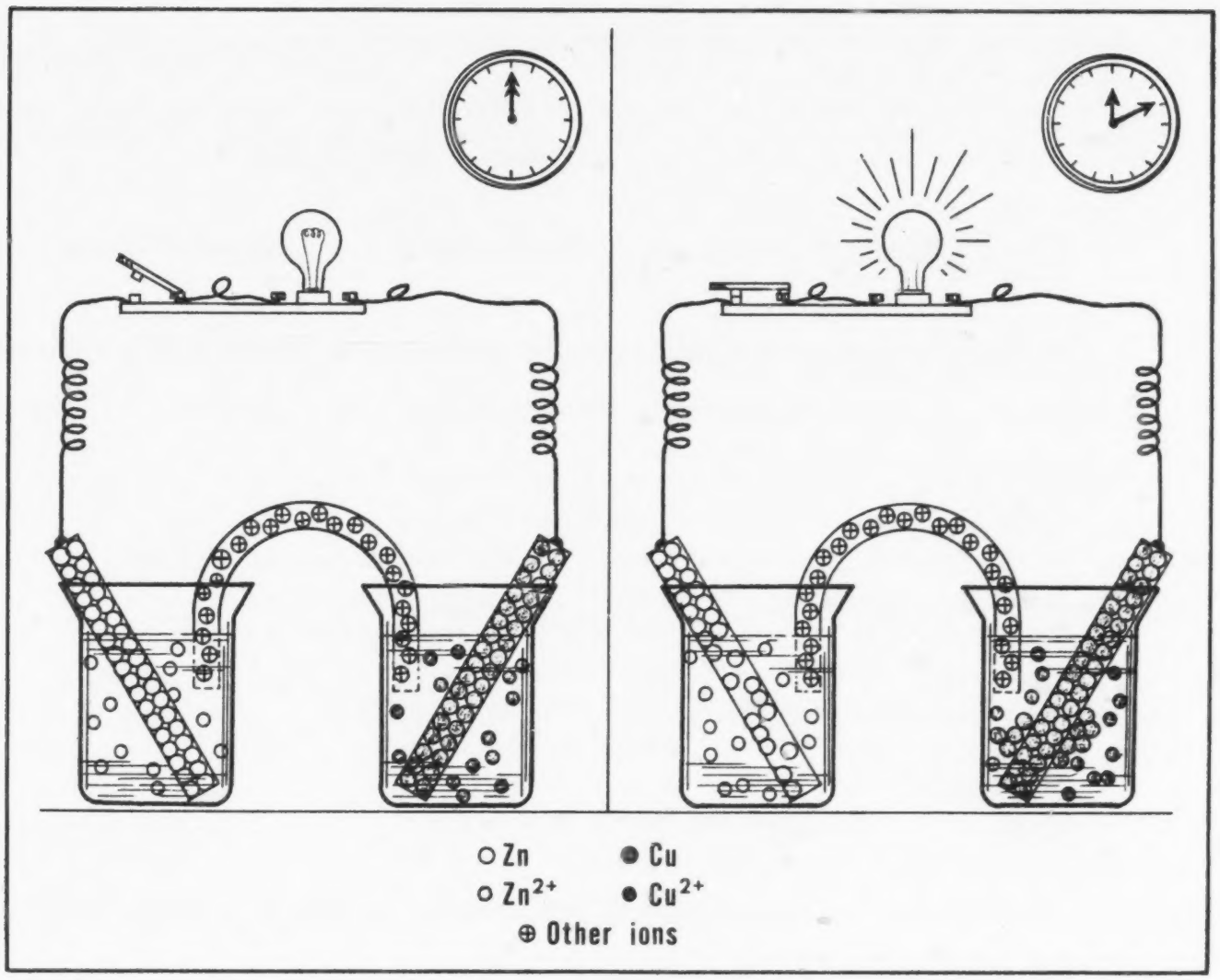
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 17-18, 79-83, 154, 187, 200, 221-223.

f. Transparency Master

"Electrical Energy from Chemical Change"

ELECTRICAL ENERGY FROM CHEMICAL CHANGE



$$Zn \longrightarrow Zn^{2+} + 2e^-$$

$$2e^- + Cu^{2+} \longrightarrow Cu$$

18) CHEMICAL EQUILIBRIA

a. Textbook Errors Summary

THE LAWS OF REACTION RATES AND OF EQUILIBRIUM, Mysels, K. J., J. Chem. Ed., 33, 178 (1956)

The form of an equilibrium constant is often derived from rate laws based on the overall reaction equation. These rate laws often do not reflect the actual reaction mechanism but the derivation is still valid since the position of equilibrium does not depend on the mechanism of reaction.

MORE ABOUT THE LAWS OF REACTION RATES AND OF EQUILIBRIUM, Guggenheim, E. A., J. Chem. Ed., 33, 544 (1956)

The kinetic behavior of a reaction cannot be predicted from the stoichiometry of the reaction; it must be determined experimentally. Guldberg and Waage were not the first to note the relationship between the quantitative expression for the equilibrium constant and the stoichiometric reaction equation.

THE VAPOR PRESSURE OF HYDRATED CUPRIC SULFATE, Logan, T. S., J. Chem. Ed., 35, 148 (1958)

The system cupric sulfate-water is frequently used to illustrate phase equilibria. The data generally quoted are not in agreement with the most reliable values reported, particularly for the $CuSO_4 \cdot H_2O$-$CuSO_4$ equilibrium.

b. References

1. Chemical Equilibrium, Hamm, Randall E. and Carl J. Nyman, Raytheon Education Co., 128 pp. (1968) - $2.50
2. Principles of Chemical Equilibrium (2nd Ed.), Morris, Kelso, Reinhold Book Corp., 128 pp. (1967) - $2.25
3. Chemical Equilibrium, Bard, Allen J., Harper and Row, 202 pages (1966) - $3.75
4. Chemical Principles in Calculations of Ionic Equilibrium, Margolis, Emil J., Macmillan, 416 pp. (1966) - $3.95

c. Selected Films

1. Equilibrium - the Limit of Disorder - ROB, $180. (16mm, B/W, sound, 30 min.)
2. Equilibrium - MLA, cat. no. 4124, $160. (16mm, color, sound, 24 min.)

d. Other Teaching Aids

Teacher Training Introduction to "Equilibrium" - MLA, cat. no. 4024, $40. (16mm, B/W, sound, 7 min.)

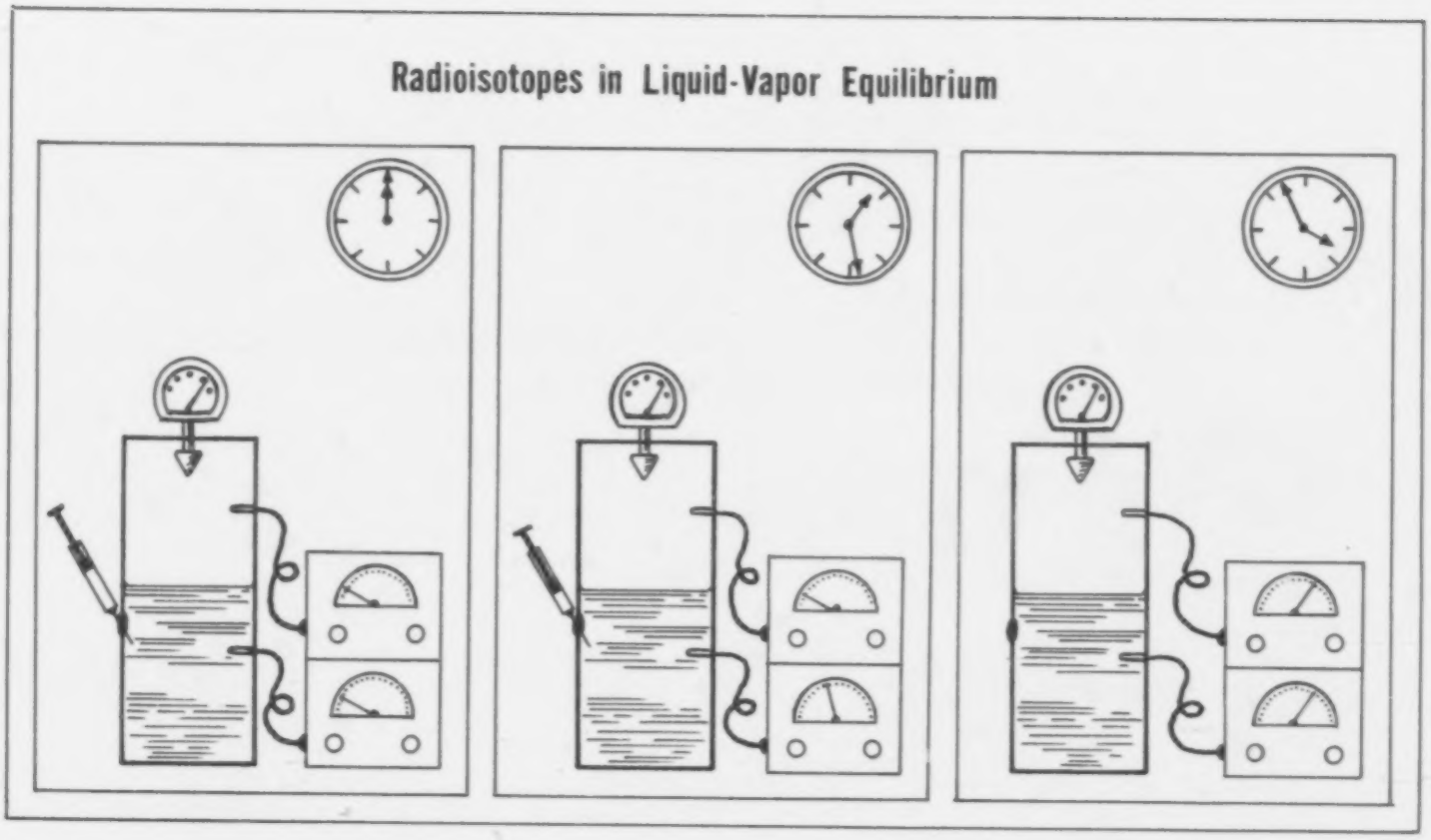
e. Selected Lecture Demonstrations

Numerous excellent demonstrations are listed in: Tested Demonstrations in Chemistry, Alyea and Dutton and Microchemistry Projected, Alyea

f. Transparency Master

"Dynamic Equilibrium"

DYNAMIC EQUILIBRIUM



19) ACID-BASE SYSTEMS

a. Textbook Errors Summary

THE IONIZATION CONSTANT OF WATER, Dirkse, T. P., J. Chem. Ed., 38, 260 (1961)

In formulating the ionization constant of water, the activity of the water is usually ignored. This can lead to appreciable errors in calculations involving concentrated solutions.

THE NATURE OF IONIC AND MOLECULAR SPECIES IN SULFURIC ACID, Brubaker, C. H., Jr., J. Chem. Ed., 34, 325 (1957)

Sulfuric acid may be thought to be relatively weak due to the small second ionization constant. Actually, the acid strength of concentrated sulfuric acid is comparable with perchloric acid.

THE SOLUBILITY OF PHENOL IN CARBONATE SOLUTIONS, Mysels, K. J., J. Chem. Ed., 35, 568 (1958)

Contrary to some texts, phenol is soluble in sodium carbonate solution, being a stronger acid than the bicarbonate ion.

b. References

1. Acids, Bases, and the Chemistry of the Covalent Bond, Vander Werf, C. A., Reinhold Book Corp., 128 pp. (1961) - $2.25
2. Acids and Bases - Drago, Russell S. and Nicholas A. Matwiyoff, Raytheon Education Co. 128 pp. (1968) - $2.50

c. Selected Films

1. Ionization and Ionic Equilibrium - INDU, cat. no. FSC - 427, $150. (16mm, color, sound, 15 min.)
2. Acid-Base Indicators - MLA, cat. no. 4130, $150. (16mm, color, sound, 19 min.)
3. Acid-Base Indicators - MLA, cat. no. 4002, $21 (S-8, color, silent, 4 min.)
4. The pH Meter - WIL, $19. (S-8, color, silent, 4 min.)
5. pH Meter - HR, cat. no. 04-96356, $25. (S-8, color, silent, 4 min.)
6. Buffer Solutions - HR, cat. no. 04-96372, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - REC

   cat. no. 21748 - "Neutralization" - $4.00

   cat. no. 21749 - "Chart of Acid and Base Strengths" - $3.80

   cat. no. 21750 - "Protonic Exchange Reactions" - $2.70
2. Simplifying and Strengthening the Teaching of pH Concepts and Calculations Using Log-Chart Transparencies, Freiser, Henry, School Science and Mathematics, 227-242, March 1967.

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 11-12, 61-62, 120, 128, 144, 147, 155, 163, 167, 194
2. Microchemistry Projected, Alyea Demonstration Numbers: 1-16

f. Transparency Master

"Acid-Base Definitions"

ACID-BASE DEFINITION

ARRHENIUS:

ACID- H^+ Source in water

BASE- OH^- Source in water

e.g. (Neutralization)

$$\underset{\text{(acid)}}{HBr_{(aq)}} + \underset{\text{(base)}}{NaOH_{(aq)}} \longrightarrow \underset{\text{(salt)}}{NaBr_{(aq)}} + \underset{\text{(water)}}{H_2O}$$

BRØNSTED-LOWRY:

ACID- H^+ Donor

BASE- H^+ Acceptor

e.g. (Competition for proton)

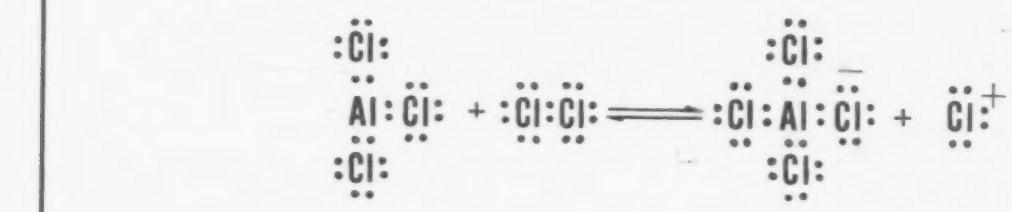
$$\underset{(acid_1)}{NH_4^+} + \underset{(base_2)}{H_2O} \rightleftharpoons \underset{(base_1)}{NH_3} + \underset{(acid_2)}{H_3O^+}$$

LEWIS:

ACID- Electron-pair acceptor

BASE- Electron-pair donor

e.g. (Competition for electron-pair)



20) OXIDATION-REDUCTION AND ELECTROCHEMISTRY

a. Textbook Errors Summary

THE STANDARD ELECTRODE POTENTIAL OF THE SILVER-SILVER BROMIDE ELECTRODE, Venable, R. L. and D. V. Roach, J. Chem. Ed., 46, 741 (1969)

The absolute magnitude of the standard electrode potential for the silver-silver bromide electrode relative to the standard hydrogen electrode is erroneously listed in several textbooks as 0.095.

THE REACTION OF THE LECLANCHE DRY CELL, Mysels, K. J., J. Chem. Ed., 32, 638 (1955)

The role of the MnO_2 in the Leclanche dry cell is not simply to scavenge the hydrogen produced at the anode. The emf for reduction of the MnO_2 makes a contribution to the total emf of the cell, and $ZnMn_2O_4$ is an important end product.

THE DEFINITION OF TRANSFERENCE NUMBERS IN SOLUTION, Spiro, M., J. Chem. Ed., 33, 464 (1956)

The common definition of transference numbers in terms of fraction of total current has an operational meaning only in simplest systems. The advantage of an operational definition in terms of ion constituents is discussed.

b. References

1. Ions in Aqueous Systems, Moeller, T. and R. O'Connor, McGraw-Hill (1970) - $(?)
2. Introduction to Electrochemistry, Lyons, Ernest H., Jr., Raytheon Education Co., 128 pp. (1967) - $2.50
3. Electroanalytical Principles, Murray, R. W. and C. N. Reilley, Wiley and Sons, 124 pp. (1963) - $2.95
4. The Glass Electrode, Eisenman, G., R. Bates, G. Mattack, and S. M. Friedman, Wiley and Sons, 332 pp. (1966) - $7.00
5. Potentiometry (Handbook of Analytical Chemistry), Meites, Louis, McGraw-Hill (1963)
6. Sign Conventions (Treatise on Analytical Chemistry - Part I), Kolthoff, I. M., Philip J. Elwing, and Ernest B. Sandell, Interscience Encyclopedia, Inc., 326-358 (1959)

c. Selected Films

1. Oxidation-Reduction - SUTH, $135. (16mm, color, sound, 16 min.)
2. The Development of Electrochemistry - IFB, cat. no. 2 IFB 393, $195. (16mm, color, sound, 19 min.)
3. Electrochemical Cells - MLA, cat. no. 4133, $165. (16mm, color, sound, 22 min.)
4. Faraday's Law - MGHT, cat. no. 612021, $190. (16mm, color, sound, 16 min.)
5. An Electrochemical Cell (Animated Mechanism) - MLA, cat. no. 4007, $21. (S-8, color, silent, 4 min.)
6. A Copper-Silver Electrochemical Cell - MLA, cat. no. 4005, $21. (S-8, color, silent, 4 min.)
7. A Silver-Hydrogen Electrochemical Cell - MLA, cat. no. 4015, $21. (S-8, color, silent, 4 min.)
8. Galvanic Cells: Half Cell Reactions - HR, cat. no. 84-0207/1, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - REC
   cat. no. 21736 - "Electrolysis" - $7.10
   cat. no. 21739 - "Galvanic Cells" - $8.20

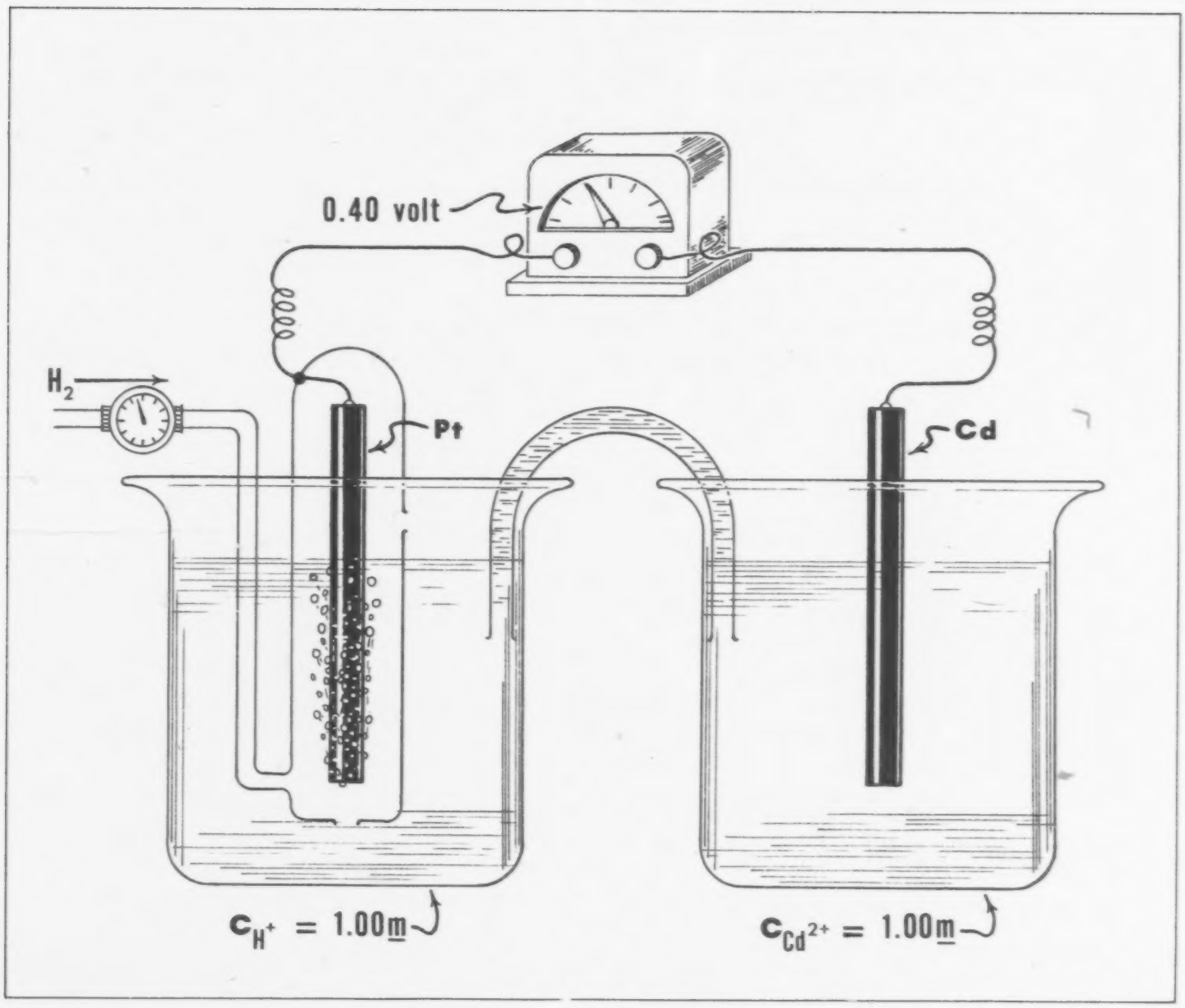
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 18, 20, 87-89, 124, 141, 144-146, 150, 151, 154, 160, 165, 168, 171, 185, 193, 196, 205, 210, 212, 213, 218, 221, 222, 224.
2. Microchemistry Projected, Alyea Demonstration Numbers: 105-108, 113-124, 181-184.

f. Transparency Master

"Cell Potential"

CELL POTENTIAL



21) KINETICS AND MECHANISM

a. Textbook Errors Summary

UNIMOLECULAR GAS REACTIONS AT LOW PRESSURES, Permutter-Hayman, Berta, J. Chem. Ed., 44, 605 (1967)

At lower pressures the high-energy population becomes depleted as a consequence of the chemical reaction.

THE EFFECT OF LIGHT ON REACTIONS, Mysels, K. J., J. Chem. Ed., 35, 32 (1958)

Light cannot be thought to act as a catalyst in photochemical reactions since it is consumed in the course of the reaction and it shifts the position of equilibrium.

CATALYTIC INHIBITION BY ADSORBED HYDROGEN, Logan, S. R., J. Chem. Ed., 40, 473 (1963)

Catalytic inhibition of the decomposition of ammonia on a catalyst by hydrogen has been found to occur by a more complex mechanism than simply occupation of the active sites on the catalyst by the hydrogen.

HYDROGEN-IODINE REACTION NOT BIOMOLECULAR, Chem. and Eng. News, Jan. 16, 1967, pp. 40-41.

b. References

1. An Introduction to Reaction Kinetics, Abbott, D., Houghton-Mifflin, 120 pp. (1968)
2. Chemical Kinetics, Harris, Gordon M., Raytheon Education Co., 128 pp. (1968) - $2.50
3. Kinetics of Inorganic Reactions, Sykes, A. G., Pergamon, 302 pp. (1966) - $4.95
4. Rates and Mechanisms of Chemical Reactions, Gardiner, W. C., Jr., Benjamin, 286 pp. (1969) $4.95
5. Inorganic Reaction Mechanisms: An Introduction, Edwards, John O., Benjamin, 204 pp. (1964) $4.95
6. Problems in Organic Reaction Mechanisms, Menger, R. M., Appleton, Century, Crofts, 75 pp. (1968) - $2.95

c. Selected Films

1. Speed of Chemical Change - FAC, cat. no. 16-253, $175. (16mm, color, sound, 15 min.)
2. Catalysis - MLA, cat. no. 4127, $135. (16mm, color, sound, 17 min.)
*3. Introduction to Reaction Kinetics - MLA, cat. no. 4121, $105. (16mm, color, sound, 13 min.)
* Note that mechanism shown for HI formation is now known to be incorrect.
4. Mechanism of an Organic Reaction - MLA, cat. no. 4166, $150. (16mm, color, sound, 20 min.)
5. Reaction Kinetics - HR, cat. no. 04-96455, $25. (S-8, color, silent, 4 min.)
6. Inversion, Retention, and Racemization - HR, cat. no. 04-96513, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Teacher Training Introduction to "Catalysis" - MLA, cat. no. 4027, $70. (16mm, B/W, sound, 13 min.)
2. Teacher Training Introduction to "Mechanism of an Organic Reaction" - MLA, cat. no. 4066, $50. (16mm, B/W, sound, 9 min.)

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 19, 84-85, 130
2. Kinetics and Rate Laws

Film, or have students film with a Super-8 movie camera, significant segments of kinetics experiments from current organic and inorganic laboratory manuals. Plot data on overhead projector. Have students determine rate laws.

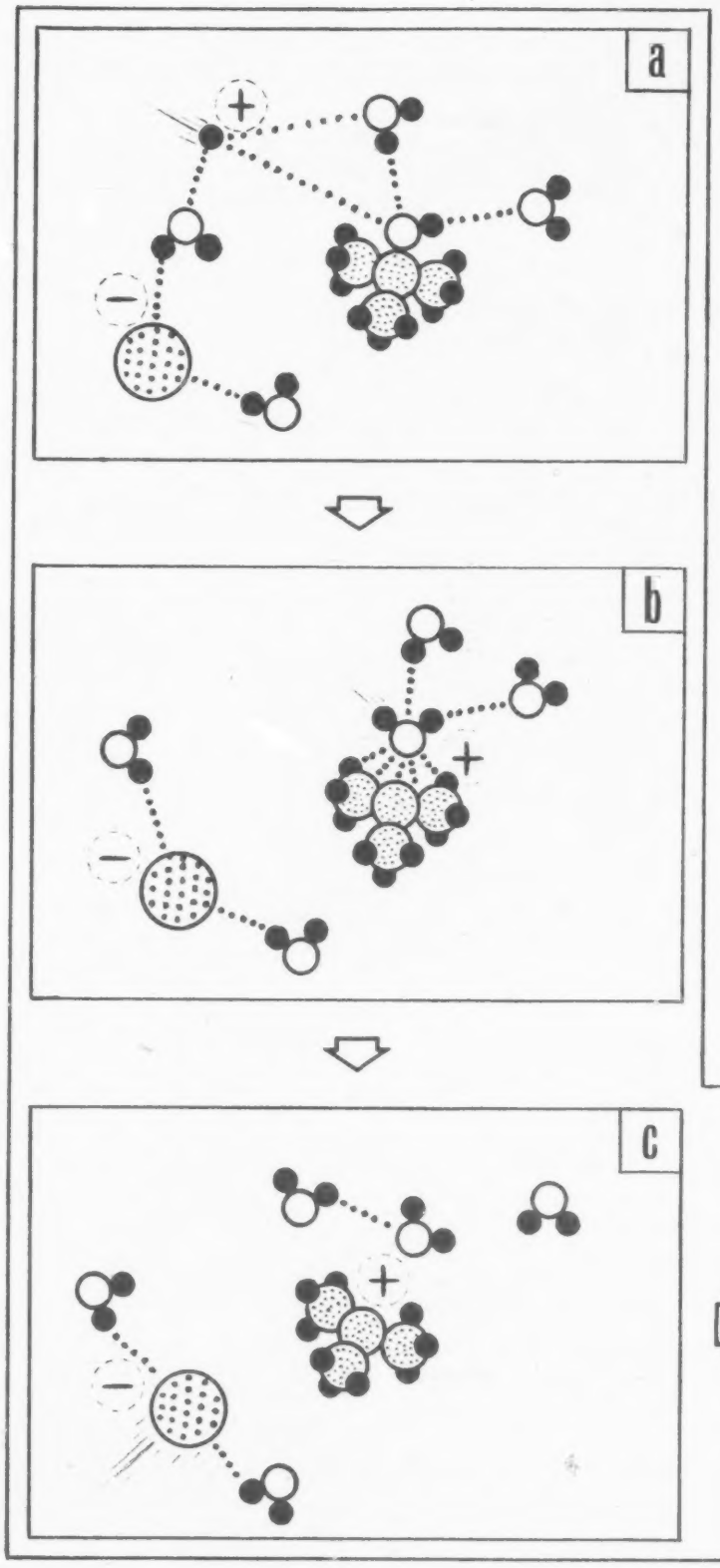
3. Animated Mechanisms

Film, or have students film, using Super-8 movie camera, reaction mechanisms using three-dimensional models. Expose 2 or 3 frames for each motion of models. For slow motions, translational movements should be about 1/16 inch and rotational movements about 15°. For faster motions, use larger movements or expose one frame per movement.

f. Transparency Master

"Mechanism of Reaction of HCl with $(CH_3)_3COH$"

MECHANISM OF REACTION
of HCl with $(CH_3)_3COH$



a.) $H^+ + (CH_3)_3COH$

b.) $\left[(CH_3)_3COH_2\right]^+$

c.) $H_2O + (CH_3)_3C^+$

Cl^-

d.) $(CH_3)_3CCl$

- Hydrogen
- Oxygen
- Carbon
- Chlorine

22) REACTIVE METALS

a. Textbook Errors Summary

THE OXYGEN COORDINATIONS OF LITHIUM, Donnay, G. and J. W. Gryder, J. Chem. Ed., 42, 223 (1965)

Lithium, usually thought to be only tetrahedrally coordinated by oxygen, has octahedral oxygen coordination in several minerals and in the nitrate and iodate.

THERMAL DECOMPOSITION OF ALKALI NITRATES, Mysels, K. J., J. Chem. Ed., 36, 303 (1959)

The statement that the decomposition temperatures of the alkali nitrates are low and that the corresponding nitrites can be prepared easily is in error.

QUALITATIVE TESTS FOR K^+, McCoy, R. E., J. Chem. Ed., 42, 444 (1965)

When the flame test is used as a confirmatory test for potassium in cobaltinitrite precipitate, the cobalt is found to interfere. The cobaltinitrite precipitate test also is of questionable value.

b. References

1. Reference Book of Inorganic Chemistry, Latimer, Wendell and Joel Hildebrand, Macmillan, 625 pp. (1965) - $4.50
2. The Theory of the Properties of Metals and Alloys, Mott, N. F. and H. Jones, Dover, 339 pp. (1968) - $2.75
3. The Chemistry of the Metallic Elements, Steele, David, Pergamon, 152 pp. (1966) - $3.45

c. Selected Films

1. Alkali Metal Reactions with Chlorine and With Water - MLA, cat. no. 4004, $21. (S-8, color, silent, 4 min.)
2. Chemical Families - MLA, cat. no. 4112, $165. (16mm, color, sound, 22 min.)
3. The Sodium Family - CORF, $180. (16mm, color, sound, 16 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies
   (VUFOIL SETS from Science Kit, Inc., 2299 Military Road, Tonawanda, New York 14150)
   cat. no. SK-77910 - "Periodicity in Chemistry" - $34.00
   cat. no. SK-77925 - "Crystal Geometry - Close Packed Structures" - $34.00

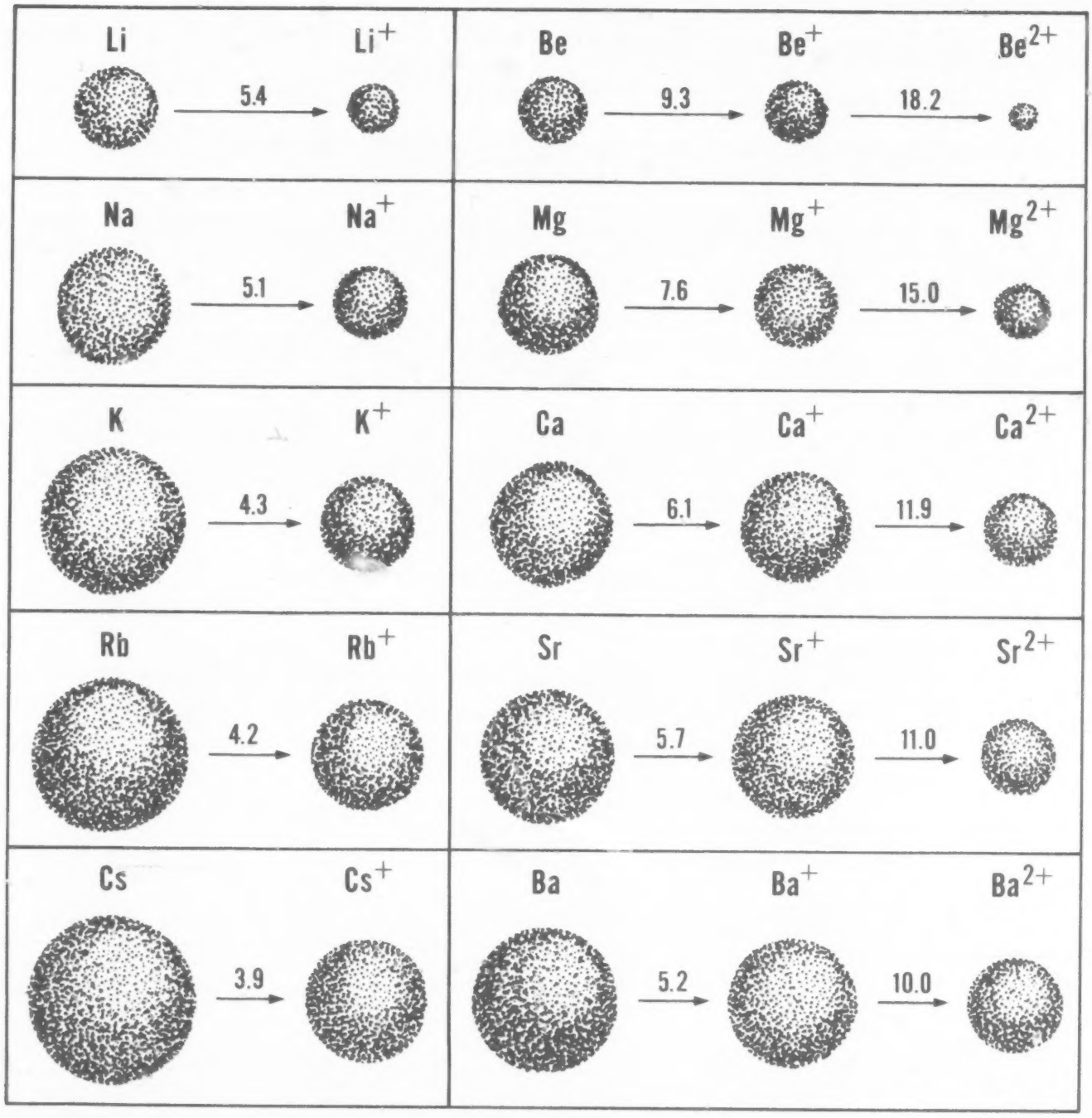
e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton
   Consult index for numerous excellent demonstrations listed by name of element.
2. Filmed Demonstrations
   Film, or have advanced students film, using a Super-8 camera, various uses of the metals or their compounds - e.g., use of a sodium press to obtain sodium wire or ribbon for drying ether, preparation or use of an organolithium compound and a Grignard reagent, use of some hydrides of the metals.

f. Transparency Master

"Relative Sizes and Ionization Potentials"

RELATIVE SIZES
and
IONIZATION POTENTIALS
(electron-volts per atom)



23) ELEMENTS OF GROUPS III A and IV A

a. Textbook Errors Summary

THE PRODUCTION OF ALUMINUM, Hendricks, B. C., J. Chem. Ed., 32, 97 (1955)

Cryolite is consumed significantly in the Hall process with important economic and air pollution consequences.

THE STRUCTURE OF SOLID ALUMINUM CHLORIDE, Bigelow, M. Jerome, J. Chem. Ed., 46, 495 (1969)

Unfortunately, most of the texts which include the bridge structure of aluminum chloride did not complete the story with a correct statement regarding the structure of the solid. A correct description of the structure of solid aluminum chloride could be found in only one text, that of Masterton and Slowinski. In liquid and gaseous aluminum chloride, (Al_2Cl_6), each aluminum atom is surrounded by a slightly distorted tetrahedron of chlorine atoms. However, in solid aluminum chloride, each aluminum atom is surrounded octahedrally by six chlorine atoms.

b. References

1. Collected Readings in Inorganic Chemistry, Editors - Watt and Kieffer, Chemical Education Publishing Co., (1962) - $3.50
2. Structural Principles in Inorganic Compounds, Addison, W. E., Wiley and Sons, 183 pp. (1961) $5.00
3. The Metalloids, Rochow, Eugene G., Raytheon Education Co., 128 pp. (1968) - $2.50

c. Selected Films

1. Corrosion III - Aluminum - WIL, $19. (S-8, color, silent, 4 min.)
2. The Modern Chemist - Diamond Synthesis - SUTH, $130. (16mm, color, sound, 13 min.)
3. Silicon and Its Compounds - CORF, $150. (16mm, color, sound, 14 min.)

d. Other Teaching Aids

Lecture-Size Models - Write for catalog from:

Science Related Materials, Inc.
P.O. Box 1009
Evanston, Illinois 60204

e. Selected Lecture Demonstrations

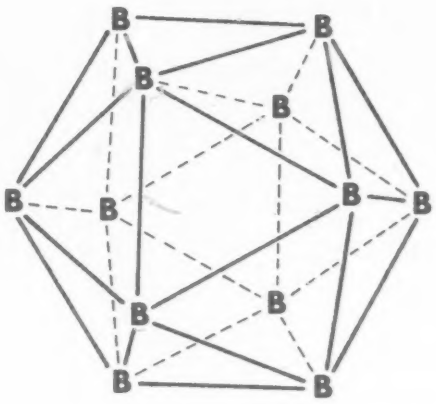
See listings by name of element in:

Tested Demonstrations in Chemistry, Alyea and Dutton

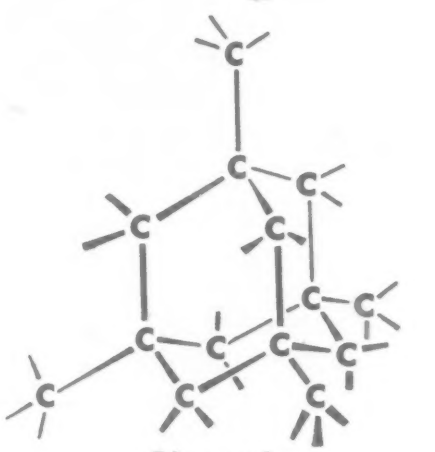
f. Transparency Master

"Crystal Lattices - Boron and Diamond"

CRYSTAL LATTICES



Boron



Diamond

24) ELEMENTS OF GROUPS V A AND VI A

a. Textbook Errors Summary

ARSENIC (V) CHLORIDE, Dasent, W. E., J. Chem. Ed., 34, 535 (1957)

There is no evidence to support the existence of arsenic (V) chloride. Some elements of the first long period of the Periodic Table are noted to be reluctant to assume their highest expected covalences.

THE THERMAL DECOMPOSITION OF $KClO_3$, Bostrup, O., K. Demandt, and K. O. Hansen, J. Chem. Ed., 39, 573 (1962)

Thermal decomposition of potassium chlorate catalyzed by manganese dioxide is quoted often as a convenient source of oxygen. Chlorine containing gases such as Cl_2 and ClO_2 also are formed.

"MONOVALENT" OXYGEN COMPOUNDS, Mysels, K. J., J. Chem. Ed., 38, 627 (1961)

Compounds based on 9-oxyanthracene have been mistakenly thought to be examples of stable oxygen free radicals.

THE THERMAL STABILITY OF H_2Se, Hayes, K. E. and N. R. M. Haase, J. Chem. Ed., 40, 149 (1963)

H_2Se is often stated to be thermally unstable. Experiments show that H_2Se is stable at least to 280°C although mixtures of H_2Se and air are readily decomposed at this temperature.

b. References

1. The Inorganic Chemistry of Nitrogen, Jolly, Wm. L., Benjamin, 136 pp. (1964) - $4.95
2. Introductory Descriptive Chemistry: Selected Non-metals, Their Properties and Behavior, Johnson, Ronald C., Benjamin, 156 pp. (1967) - $2.95
3. The Chemistry of The Non-Metallic Elements, Sherwin, Ernest and Gordon J. Weston, Pergamon, 194 pp. (1966) - $2.95
4. The Chemistry of the OH Group - Clapp, Leallyn B., Prentice-Hall, 128 pp. (1967) - $2.95

c. Selected Films

1. Nitric Acid - MLA, cat. no. 4136, $135. (16mm, color, sound, 18 min.)
2. Nitrogen and Ammonia - CORF, $180. (16mm, color, sound, 16 min.)
3. Phosphorus - CORF, $175. (16mm, color, sound, 19 min.)
4. O for Oxygen - FAC, $175. (16mm, color, sound, 17 min.)
5. Paramagnetism of Liquid Oxygen - HR, cat. no. 80-2041/3, $25. (S-8, color, silent, 4 min.)
6. Chemistry of Water - SUTH, $135. (16mm, color, sound, 14 min.)
7. Sulfur and Its Compounds - CORF, $150. (16mm, color, sound, 14 min.)

d. Other Teaching Aids

Transparencies - REC - $6.00 each

cat. no. 21732 - "Electronegativity According to Pauling"

cat. no. 21742 - "The Effect of Hydrogen Bonding"

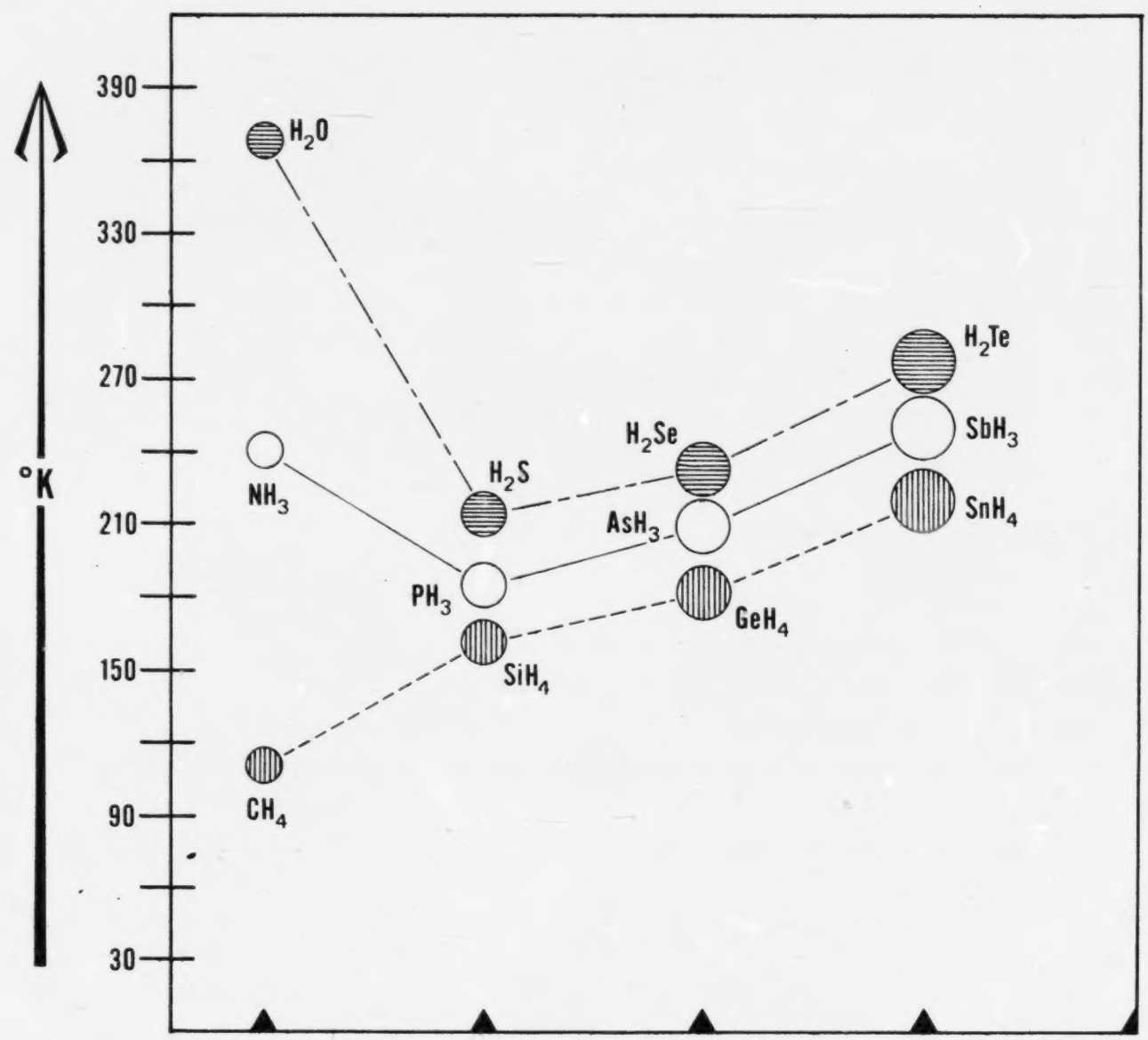
e. Selected Lecture Demonstrations

See listing by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton

f. Transparency Master

"Hydrogen Bonding and Boiling Point"

HYDROGEN BONDING
and
BOILING POINT
(at 1 atm.)



25) HALOGENS AND NOBLE GASES

a. Textbook Errors Summary

THE CHROMYL CHLORIDE TEST FOR CHLORIDES, Mysels, K. J., J. Chem. Ed., 38, 627 (1961)

Iodine or bromine may interfere with the chromyl chloride test for chloride.

b. References

1. The Chemistry of the Non-Metals, Jolly, William, Prentice-Hall, 149 pp. (1966) - $2.95
2. The Chemistry and Chemical Technology of Fluorine, Neumark, H. R., et al., Wiley and Sons, 342 pp. (1967) - $9.50
3. The Noble Gases, Claasen, Howard H., Raytheon Education Co., 128 pp. (1966) - $2.50
4. Frey, John E., "Discovery of the Noble Gases and Foundations of the Theory of Atomic Structure," J. Chem. Ed., 43, 371-74 (1966)

c. Selected Films

1. The Family of Halogens - MGHT, cat. no. 612025, $150. (16mm, color, sound, 13 min.)
2. Chlorine - A Representative Halogen - SUTH, $135. (16mm, color, sound, 15 min.)
3. Bromine - Element from the Sea - MLA, cat. no. 4169, $165. (16mm, color, sound, 22 min.)
4. Chemical Somersault - AEC, free loan (16mm, B/W, sound, 29 min.)
5. A Research Problem: Inert (?) Gas Compounds - MLA, cat. no. 4160, $150 (16mm, color, sound, 19 min.)

d. Other Teaching Aids

None listed

e. Selected Lecture Demonstrations

1. See listings by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton.
2. Preparation of Chlorine, Bromine, and Iodine

   Materials: 50 ml beakers, stirring rods, eyedroppers, CCl_4, Clorox, 3 M HCl, 0.10 M NaBr, 0.10 M NaI, overhead projector, acetates, pens.

   Procedure: Place four beakers on overhead projector and add a shallow layer of CCl_4. To first add 1 drop HCl. To second add 5 ml NaBr, then 1 drop HCl with stirring. To third add 5 ml NaI and 1 drop HCl with stirring. Add 1 ml Clorox to each and stir vigorously. Compare. Write equations on acetate.
3. "Anomolous" Properties of Fluoride

   Materials: 50 ml beakers, stirring rods, eyedroppers, 0.1 M HF, 0.1 M HCl, 0.1 M HBr, 0.1 M HI, 0.1 M NaF, 0.1 M NaCl, 0.1 M NaBr, 0.1 M NaI, 0.05 M $AgNO_3$, 0.1 M $Ca(NO_3)_2$, Universal pH indicator solution, overhead projector, acetates, pens, 35mm color slides of freshly precipitated AgCl, AgBr, AgI, CaF_2.

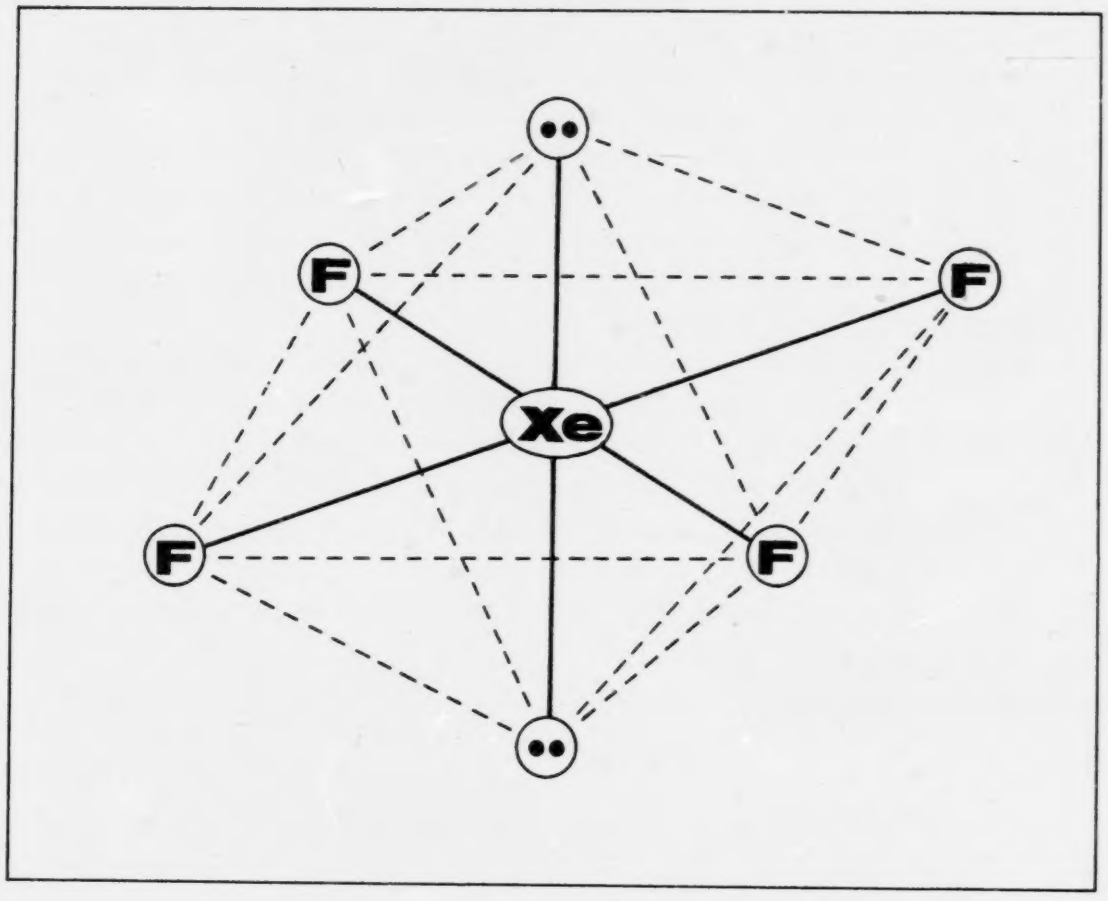
   Procedure: Show reactions of acids and salts with pH indicator and reactions of salts with $AgNO_3$ and $Ca(NO_3)_2$ on overhead project. After each precipitation show color slide of precipitate. Write equations on acetate as reactions occur.

f. Transparency Master

"Xenon Tetrafluoride"

XENON TETRAFLOURIDE

A Chemical Suprise



26) TRANSITION ELEMENTS

a. Textbook Errors Summary

THE CONDUCTIVITY OF COMPLEXES, Mysels, K. J., J. Chem. Ed., 36, 303 (1959)

Conductivity measurements are used often to determine the structure of complexes. To do this, one must clearly understand the difference between equivalent and molar conductance.

THE EQUILIBRIA OF COMPLEX FORMATION, Banks, J. E., J. Chem. Ed., 38, 391 (1961)

The intermediate species in the formation of a complex ion are often erroneously ignored in calculations involving the formation constant of the ion.

THE COMPARISON OF STABILITY CONSTANTS, Agterdenbos, J., J. Chem. Ed., 45, 230 (1968)

In several texts of analytical chemistry the stability of complexes with polydentate ligands is incorrectly compared with that of unidendate ligands.

CRYSTAL FIELD SPLITTING DIAGRAMS, Zuckerman, J. J., J. Chem. Ed., 42, 315 (1965)

The ratios of energy terms for ligand-metal ion attraction, ligand-d-electron repulsion and d-orbital splitting by the crystal field are frequently inadequately emphasized.

SUBSTITUTION REACTIONS IN OCTAHEDRAL COMPLEXES, Jones, G. R. H., J. Chem. Ed., 43, 657 (1966)

Not all nucleophilic substitution reactions of octahedral complexes go via an aquo complex in aqueous solution. A number go by direct substitution.

TURNBULL'S BLUE AND PRUSSIAN BLUE: $KFe(III)[Fe(II)(CN)_6]$, Hansen, Lee D., William M. Litchman, and Guido H. Daub, J. Chem. Ed., 46, 47 (1969)

It has been shown by three independent methods that the composition of these blues corresponds to $KFe(III)[Fe(II)(CN)_6]$.

DECOLORIZATION OF GLASS, Dingledy, David, J. Chem. Ed., 42, 160 (1965)

In the decolorization of glass, MnO_2 does not oxidize Fe(II) to Fe(III) but acts as a physical decolorizer, masking the blue-green color of Fe(II) by addition of a complementary red color.

SOLUBILITY OF GOLD IN MERCURY, Brown, J. B., J. Chem. Ed., 37, 415 (1960)

Gold is not very soluble in mercury, and the amalgamation process for gold recovery depends on the wetting of gold by the mercury and not the solubility of gold in mercury.

b. References

1. Coordination Chemistry, Quagliano, J. V. and L. J. Vallarino, Heath-Raytheon, 128 pp. (1969) $2.50
2. Transitional Elements, Larsen, Edwin M., Benjamin, 195 pp. (1965) - $2.45
3. Coordination Chemistry, Basolo, Fred and Ronald C. Johnson, Benjamin, 192 pp. (1964) - $2.95
4. Inorganic Complex Compounds, Murmann, R. K., Reinhold Book Corp., 128 pp. (1964) - $2.25
5. Symmetry in Inorganic Chemistry, Dorain, Paul B., Addison-Wesley, 122 pp. (1965) - $2.50

c. Selected Films

1. Vanadium - A Transition Element - MLA, cat. no. 4172, $165. (16mm, color, sound, 22 min.)
2. Chromium and Manganese - CORF, $350. (16mm, color, sound, 38 min.)
3. Cation Analysis - Wet-Chemical Methods - HR, cat. no. 04-96398, $25. (S-8, color, silent, 4 min.)
4. Cation Analysis - Chromatography and Ion Exchange - HR, cat. no. 04-96414, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Teacher Training Introduction to "Vanadium - A Transition Element" - MLA, cat. no. 4072, $40. (16mm, B/W, sound, 7 min.)

e. Selected Demonstrations

See listings by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton.

f. Transparency Master

"Geometries of Complexes"

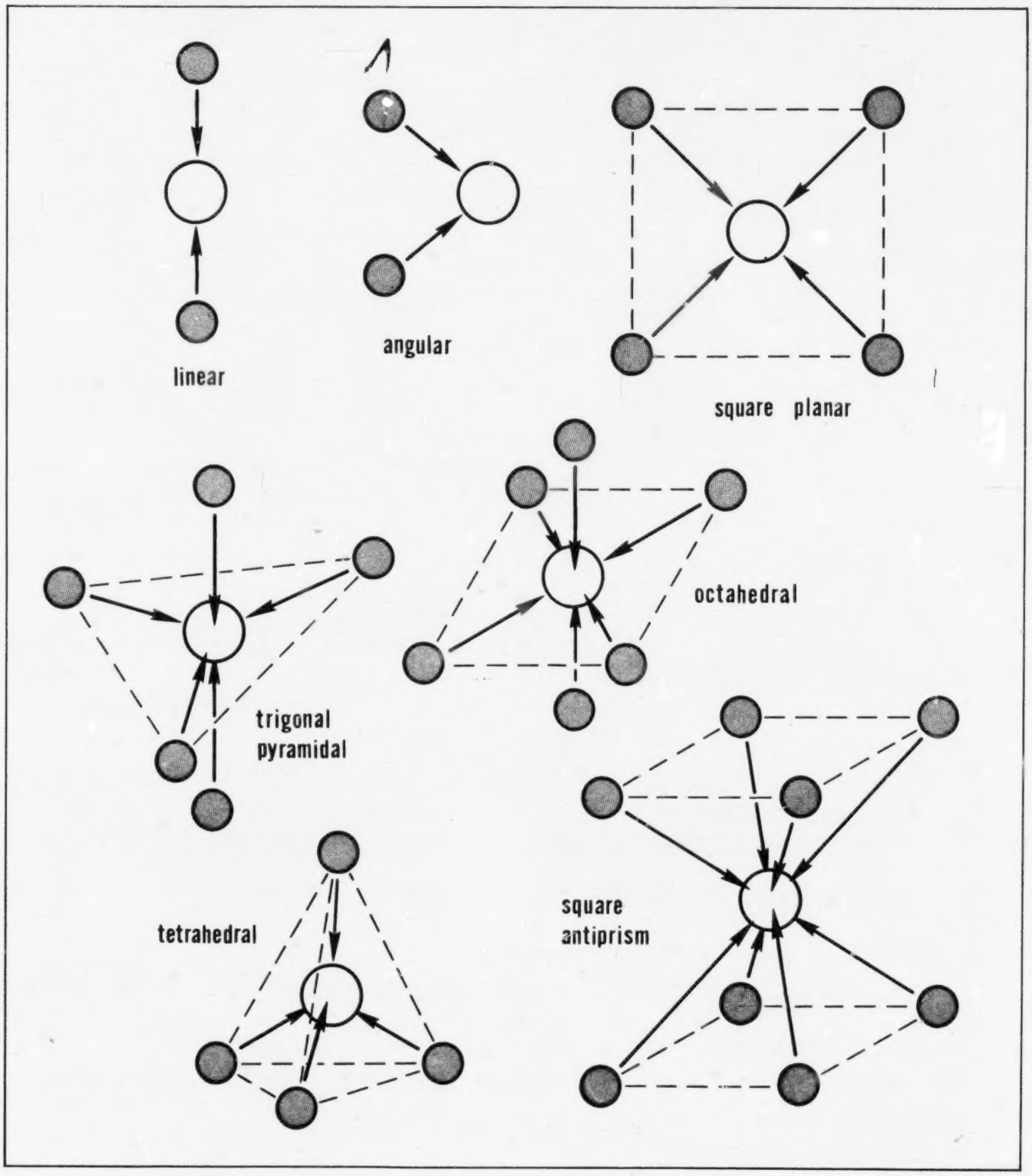
GEOMETRIES OF COMPLEXES
(idealized)

Cation or atom

Ligand

Coordinate bond

Definition of planes



27) ORGANIC CHEMISTRY: HYDROCARBONS

a. Textbook Errors Summary

PERMANGANATE HYDROXYLATION OF ALKENES, Snyder, C. H., J. Chem. Ed., 43, 141 (1966)

Texts often cite neutral potassium permanganate as a reagent for conversion of alkenes to cis-glycols. Usually, alkaline permanganate is distinctly superior.

HALOGENATION AND OLEFINIC NATURE OF CYCLOPROPANE, Gordon, Arnold J., J. Chem. Ed., 44, 461 (1967)

Because of its unusual reactions the cyclopropane ring is inaccurately referred to as olefin-like.

THE SIDE-CHAIN HALOGENATION OF n-ALKYL BENZENES, Goldwhite, H., J. Chem. Ed., 37, 295 (1960)

These reactions are sensitive to the reaction conditions and isomer mixtures often occur.

FREIDEL-CRAFTS ALKYLATION, Marsi, K. L. and S. H. Wilen, J. Chem. Ed., 40, 214 (1963)

Large percentages of n-alkylated products in some cases suggests a competing nucleophilic displacement mechanism.

ORGANIC NOMENCLATURE - I, Liotta, Charles, J. Chem. Ed., 47, 471 (1970)

Common errors in the naming of alkanes, alcohols, carbonium ions, and pyrimidines are discussed.

b. References

1. A Guide to Understanding Basic Organic Reactions, Whitfield, R. C., Houghton-Mifflin, 120 pp. (1969) - $1.75
2. Industrial Organic Chemistry, Stille, J. K., Prentice-Hall, 144 pp. (1968) - $2.50
3. Organic Nomenclature: A Programmed Introduction, Traynham, J., Prentice-Hall, 128 pp. (1966) $3.95

c. Selected Films

1. Carbon and Its Compounds - CORF, $120. (16mm, color, sound, 11 min.)
2. Hydrocarbons and Their Structures - CORF, $150. (16mm, color, sound, 13 min.)

d. Other Teaching Aids

Molecular Models - several types

Write for brochures from: Science Related Materials, Inc., P.O. Box 1009, Evanston, Ill. 60204
W. A. Benjamin, Two Park Avenue, New York, N. Y. 10016
Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632

e. Selected Lecture Demonstrations

1. Isomerism and Planar Representations

Materials: Small models, e.g., Benjamin (Maruzen) Kit, overhead projector, acetates, pens.

Procedure: Show a "linear" model of n-butane, lay the model on the overhead projector, and print a typical "linear expanded" formula to match the shadow pattern. Using the same model twisted into other shapes, show alternative representations for the same compound. Then follow the same procedure for isobutane. Contrast isomers with simple alternative planar representations.

2. Bromine and Hydrocarbons

Materials: 50 ml beakers, stirring rods, dilute bromine in carbon tetrachloride, iron nails, pure samples of cyclohexane, cyclohexene, benzene, acetylene gas, overhead projector, acetates, pens.

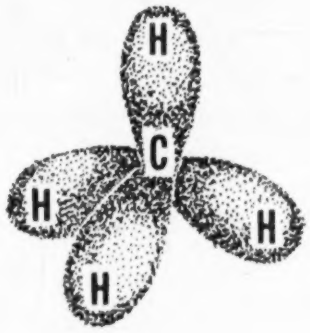
Procedure: Place cyclohexane and cyclohexene in beakers on projector and add bromine solution with stirring, counting drops. Then place bromine solution in beaker and bubble in acetylene gas slowly. Finally, place two beakers of benzene (one containing an iron nail) and one of cyclohexene on the projector. Add bromine to these and allow to stand on the lighted projector. Write equations for reactions.

Discuss: Addition, nucleophilic substitution, free radical reaction, bond delocalization.

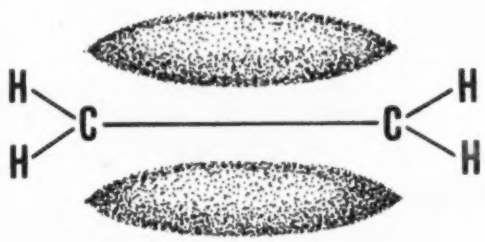
f. Transparency Master

"Orbital Representations"

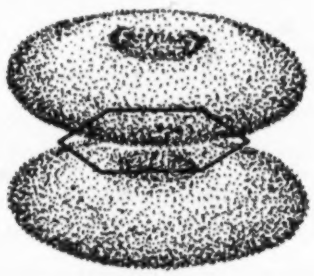
ORBITAL REPRESENTATIONS



Sigma bonds in methane



Pi bond in ethylene



Pi bond in benzene

28) ORGANIC CHEMISTRY: FUNCTIONAL GROUPS

a. Textbook Errors Summary

THE DIRECT ESTERIFICATION OF PHENOLS, Offenhauer, R. D., J. Chem. Ed., 41, 39 (1964)

It is often possible to esterify phenols directly with carboxylic acids.

THE FEHLING AND BENEDICT TESTS, Daniels, R., C. C. Rush, and L. Bauer, J. Chem. Ed., 37, 205 (1960)

Use of the Fehling and Benedict tests to detect simple aliphatic aldehydes is not valid.

THE DECARBOXYLATION OF ORGANIC ACIDS, March, Jerry, J. Chem. Ed., 40, 212 (1963)

Simple aliphatic acids, except acetic, give mixtures on decarboxylation.

THE PYROLYTIC DECOMPOSITION OF CARBOXYLATE SALTS TO KETONES, Schultz, H. P. and J. P. Sichels, J. Chem. Ed., 38, 300 (1961)

In pyrolysis of calcium and barium carboxylates complex mixtures usually occur.

LIMITATION OF THE HINSBERG METHOD FOR PRIMARY AMINES, Fanta, P. E. and C. S. Wang, J. Chem. Ed., 41, 280 (1964)

Many primary amines, e.g., cycloalkylamines, give insoluble benzenesulfonamides.

SUBSTITUTION PRODUCTS IN THE HOFMANN ELIMINATION, Baumgarten, Ronald J., J. Chem. Ed., 45, 123 (1968)

Only a small proportion of Hofmann eliminations give exclusively alkene products.

THE ACTIVATING EFFECT OF FLUORINE IN ELECTROPHILIC AROMATIC SUBSTITUTION, Ault, Addison, J. Chem. Ed., 43, 329 (1966)

Fluorine, unlike other halogens, is found to activate the position para to it.

THE COUPLING OF DIAZONIUM SALTS, Frigerio, N. A., J. Chem. Ed., 43, 142 (1966)

Several common diazo coupling generalizations are not valid.

THE DECOLORIZATION OF BAEYER'S REAGENT BY PRIMARY AND SECONDARY ALKANOLS, Swinehart, J. S. J. Chem. Ed., 41, 392 (1964)

Primary and secondary alcohols are often said to decolorize neutral aqueous potassium permanganate. This is found generally to be untrue for saturated alcohols.

b. References

1. The Names and Structures of Organic Compounds, Benfey, Otto Theodor, Wiley and Sons, 212 pp. (1966) - $2.95
2. Organic Functional Group Analysis: Theory and Development, Schenk, George H., Pergamon, 308 pp. (1968) - $4.50
3. Organometallic Chemistry, Rochow, E., Reinhold Book Corp., 128 pp. (1964) - $2.25
4. Organic Synthesis, Ireland, R., Prentice-Hall, 176 pp. (1969) - $3.95

c. Selected Films

1. Mechanism of an Organic Reaction - MLA, cat. no. 4166, $150. (16mm, color, sound, 20 min.)
2. Reaction Kinetics - HR, cat. no. 04-06455, $25. (S-8, color, silent, 4 min.)
3. Inversion, Retention, and Racemization - HR, cat. no. 04-96513, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Programmed Review of Organic Chemistry - Nomenclature - Reactions I - Reactions II, Runquist, Olaf A., Burgess Publishing Co., (1965) - $3.00 each section
2. Teacher Training Introduction to "Mechanism of an Organic Reaction" - MLA, cat. no. 4066, $50. (16mm, B/W, sound, 9 min.)

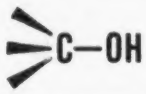
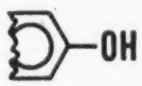
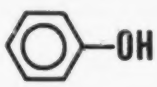
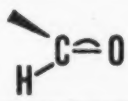
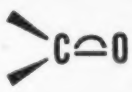
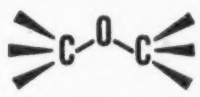
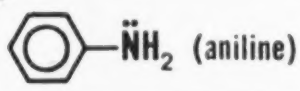
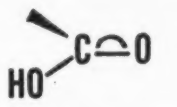
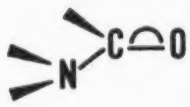
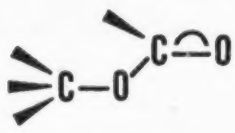
e. Selected Lecture Demonstrations

Prepare combinations of projectable demonstrations, 35mm slides, and teacher (or student) - produced super-8 films on reactions of functional groups. Laboratory manuals and textbooks on qualitative organic analysis provide many suitable examples.

f. Transparency Master

"Common Functional Groups"

COMMON FUNCTIONAL GROUPS

Group	Class	Example
(X= F, Cl, Br, I)	halide	$CHCl_3$ (chloroform)
	alcohol	CH_3CH_2OH (ethanol)
	phenol	 (carbolic acid)
	aldehyde	CH_3CHO (acetaldehyde)
	ketone	$CH_3\overset{O}{\overset{\|\|}{C}}CH_3$ (acetone)
	ether	$C_2H_5OC_2H_5$ (diethyl ether)
	amine	 (aniline)
	carboxylic acid	CH_3COOH (acetic acid)
	amide	$CH_3\overset{O}{\overset{\|\|}{C}}NH_2$ (acetamide)
	ester	$CH_3\overset{O}{\overset{\|\|}{C}}OC_2H_5$ (ethyl acetate)

29) STEREOCHEMISTRY

a. Textbook Examples Summary

THE CRITERION FOR OPTICAL ISOMERISM, Thompson, H. B., J. Chem. Ed., 37, 530 (1960)

Lack of a plane of symmetry is inadequate and should be replaced by the criterion of non-superimposable mirror images.

EVIDENCE FOR THE CONFIGURATION ON CARBON 1 OF D-GLUCOSE, Sickels, J. P. and H. P. Schultz, J. Chem. Ed., 41, 343 (1964)

The conductivity of boric acid solutions containing glucose is used to assign the configuration on carbon-1. This argument was based on a furanose structure while glucose is now known to exist in a pyranose structure for which the argument is invalid.

SYSTEMATIC NAMES FOR THE TARTARIC ACIDS, Baxter, J. N., J. Chem. Ed., 41, 619 (1964)

The tartaric acids are often named D-tartaric acid or L-tartaric acid without reference to whether the carbohydrate (Rosanoff) or amino acid systems is being used. The difference lies in whether the absolute configuration of the lowest numbered or highest numbered asymmetric carbon is taken as the basis for the nomenclature.

b. References

1. Elements of Stereochemistry, Eliel, E. L., Wiley and Sons, 98 pp. (1969) - $2.95
2. Introduction to Stereochemistry, Mislow, Kurt, Benjamin, 205 pp. (1965) - $3.95
3. Symmetry in Chemistry, Jaffe, Hans H. and Milton Orchin, Wiley and Sons, 191 pp. (1965) $3.95

c. Selected Films

1. Simple Stereochemistry - HR, cat. no. 04-96471, $25. (S-8, color, silent, 4 min.)
2. Optical Activity - HR, cat. no. 04-96497, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Lecture-Size Models

Science Related Materials, Inc., P.O. Box 1009, Evanston, Ill. 60204

e. Selected Lecture Demonstrations

1. Enantiomers

Materials: Two spherical balloons in each of four colors and in white, double surface tape, large mirror.

Procedure: Prepare in advance two mirror images of tetrahedrally-arranged colored balloons around central white balloon. Place one in front of and one behind large mirror on lecture bench. Display, then remove mirror. Show that the models are non-superimposable.

2. Optical Activity

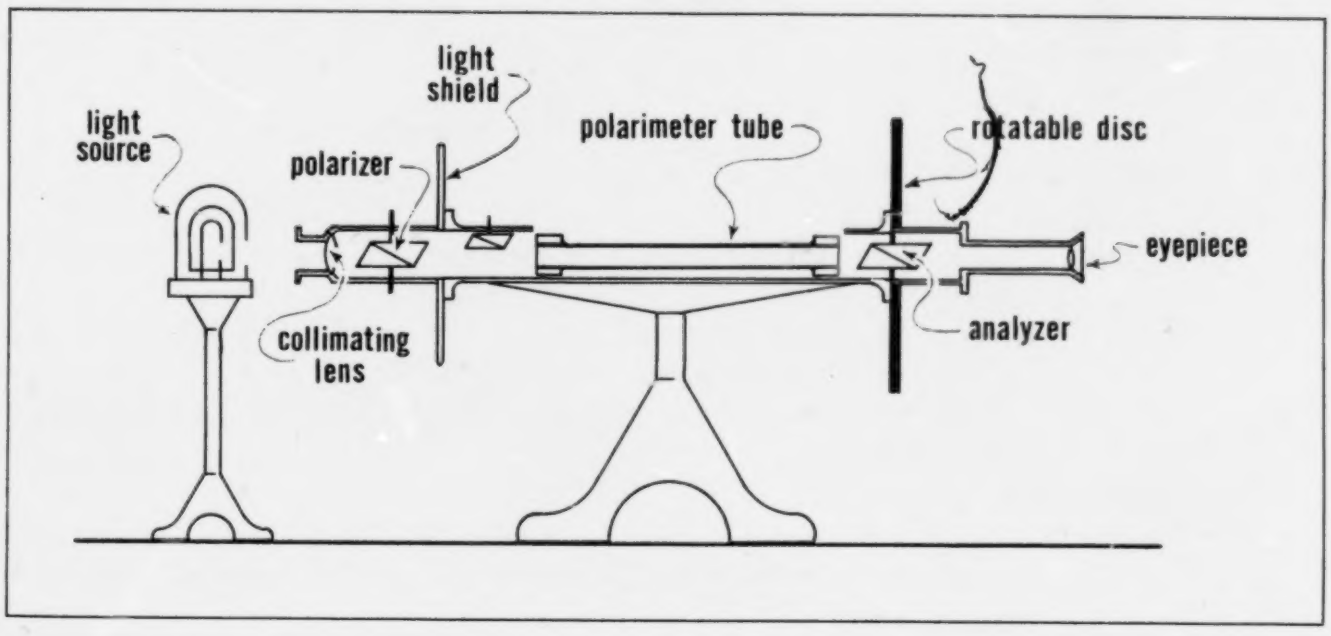
Materials: Two 10" x 10" sheets of polaroid, large petri dishes, saturated solutions of sucrose and of table salt, distilled water, overhead projector, ruler, wax marking pencil.

Procedure: Lay one polaroid sheet on projector stage and mark a line through the center parallel to one edge. Place the other sheet on top of this and rotate it until maximum light intensity is observed. Mark a line on this corresponding to the line on the first sheet. Interpose a deep petri dish of water between the two sheets, adjusting focus as necessary to obtain best projection of both lines. Observe relative sheet positions for maximum light intensity with dishes of water, salt solution, and sucrose solution. [See also: Henderson, Giles, "A TV Lecture Demonstration of Optical Activity", J. Chem. Ed., 44, 765 (1967)]

f. Transparency Master

"Polarimeter"

POLARIMETER
(cross section)



30) ABSORPTION SPECTRA

a. Textbook Errors Summary

LIGHT ABSORPTION IN PHOTOCHEMISTRY, Shaw, Henry and Sidney Toby, J. Chem. Ed., 43, 408 (1966)

Many photochemistry texts ignore some of the basic physics of light absorption. A development of the Beer-Lambert relation from Maxwell's equations is given and photoinitiated processes are discussed.

b. References

1. Introduction to Molecular Spectroscopy, Sonnessa, Anthony J., Reinhold Book Corp., 128 pp. (1966) - $2.25
2. Systematics of the Electronic Spectra of Conjugated Molecules, Platt, J. R., et al., Wiley and Sons, 378 pp. (1964) - $6.95
3. Paramagnetic Resonance: An Introductory Monograph, Pake, George E., Benjamin, 220 pp. (1962) $5.95
4. Microwave Spectroscopy, Gordy, Walter, Wm. V. Smith, and Ralph F. Trambarulo, Dover, 446 pp. (1966) - $3.00
5. Interpretation of Mass Spectra: An Introduction, Mclafferty, Fred W., Benjamin, 224 pp. (1966) - $4.95
6. Problems in Spectroscopy: Organic Structure Determination by NMR, IR, UV, and Mass Spectra, Trost, Barry, Benjamin, 416 pp. (1967) - $2.95

c. Selected Films

1. Absorption Spectra - EAL, cat. no. 80-2025, $16. (S-8, color, silent, 4 min.)
2. Visible and Ultraviolet Spectra - HR, cat. no. 04-96215, $25. (S-8, color, silent, 4 min.)
3. Molecular Spectroscopy - MLA, cat. no. 4142, $165. (16mm, color, sound, 23 min.)
4. Infrared - AEC, free loan (16mm, color, sound, 15 min.)
5. Infrared Spectroscopy - HR, cat. no. 04-96091, $25. (S-8, color, silent, 3 min.)
6. Nuclear Magnetic Resonance - WIL, $300. (16mm, color, sound, 28 min.)
7. Nuclear Magnetic Resonance - HR, cat. no. 04-96273, $25. (S-8, color, silent, 4 min.)
8. Analysis by Mass - IFB, cat. no. 3, $225. (16mm, color, sound, 27 min.)
9. Mass Spectra - HR, cat. no. 04-96190, $25. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

Prepare, or have students prepare, Super-8 films showing operation of locally-available instruments.

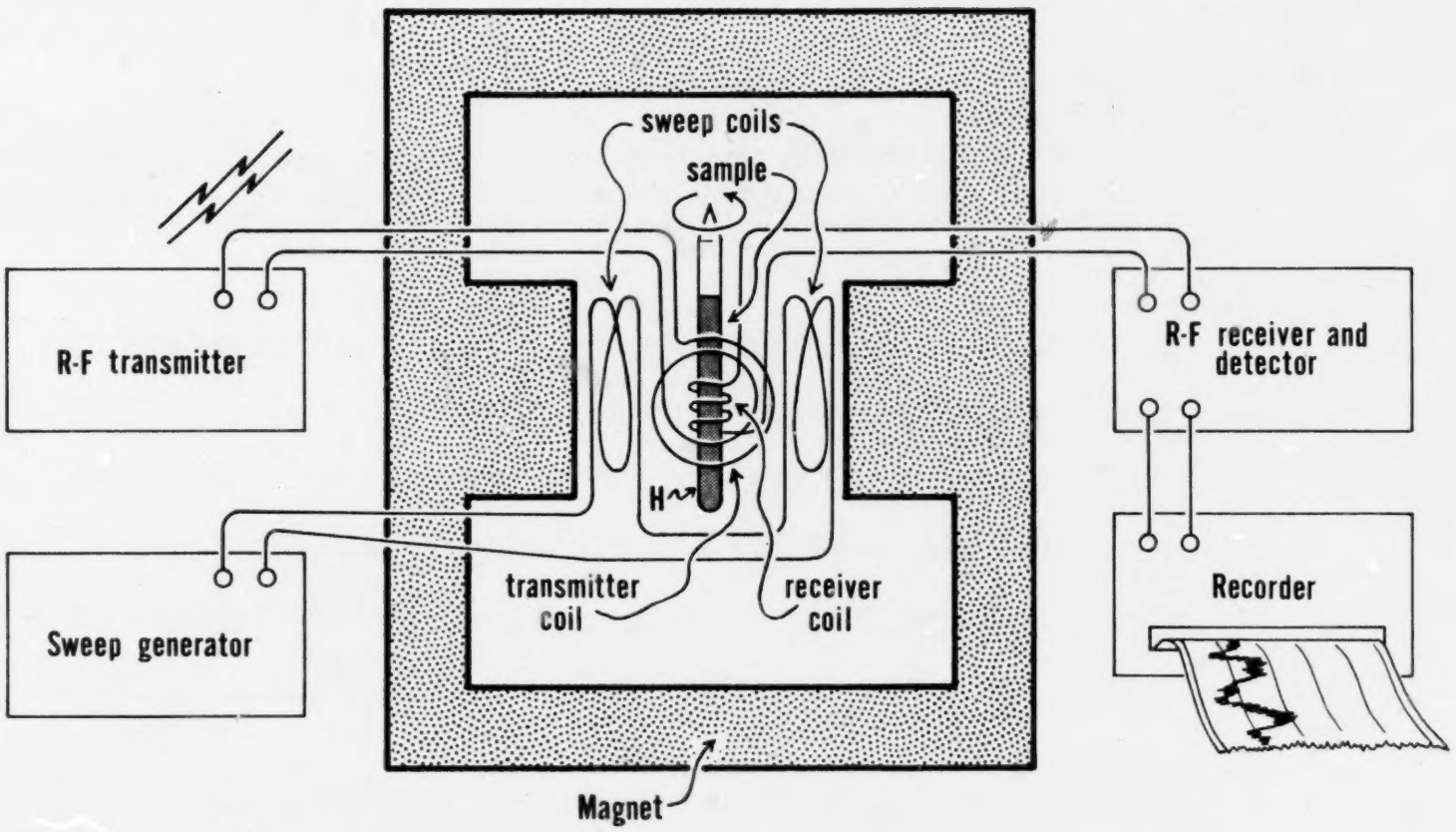
e. Selected Lecture Demonstrations

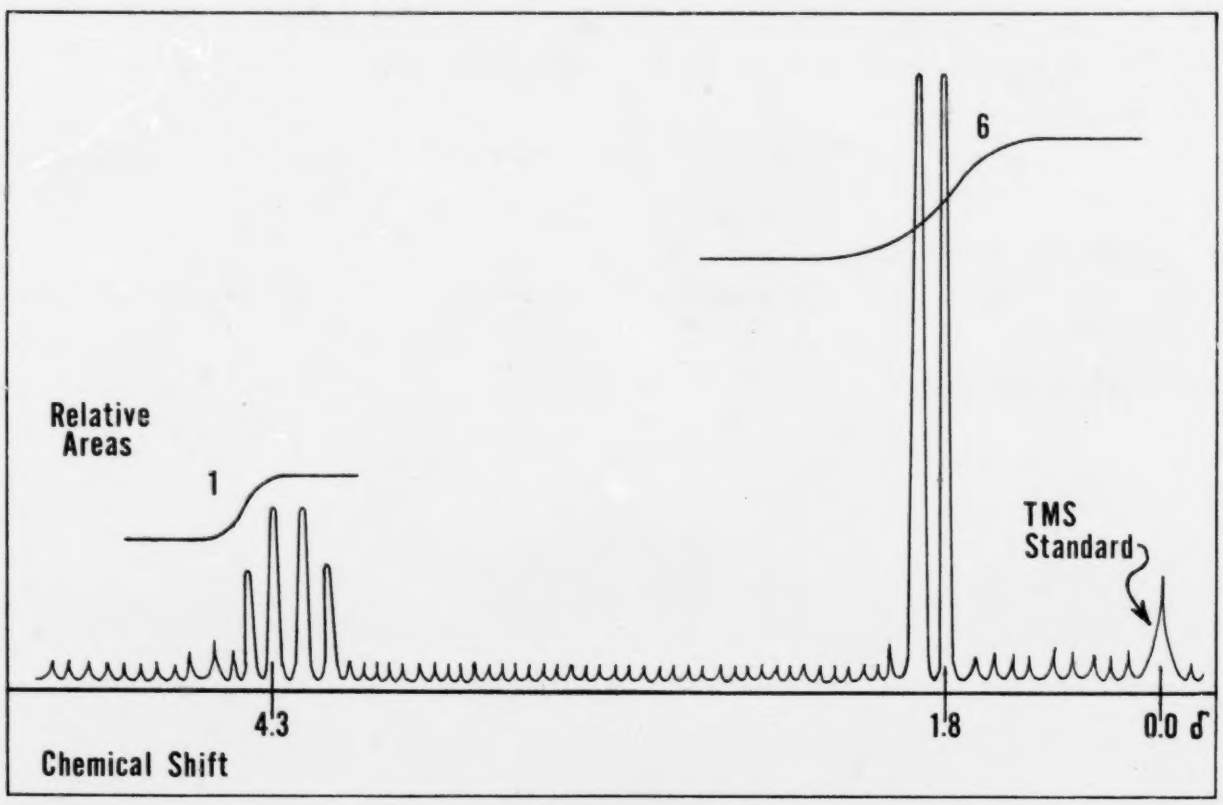
Prepare 35mm slides or transparencies of textbook or experimental spectra for student interpretation.

f. Transparency Master

"NMR"

NMR





2- bromopropane

31) MACROMOLECULES

a. Textbook Errors Summary

ERRORS IN REPRESENTING STRUCTURES OF PROTEINS AND NUCLEIC ACIDS, Day, Richard A. and Edmond J. Ritter, J. Chem. Ed., 44, 761 (1967)

All of the proteins characterized to date are known to be made up of L-amino acids. In the small number of cases where the helical sense of proteins has been determined they have been found to be right-handed. The helical sense of DNA is also known to be right-handed. It is perhaps germane to recall some of the devices used to remember the helical sense. One of the most convenient is to imagine a point travelling along the helix. One grasps the helix with the appropriate hand so that the fingers point in the direction of travel in the helical path and the thumb points in the direction of travel with respect to the helical axis. If the right hand fulfills the requirements it is a right-handed helix; the left hand, the opposite. Alternatively, one can tell the helical sense at a glance by noting that if the helical axis is vertical a line tangential to the portion of each turn of the helix closest to the observer "leans" to the right for the right-handed form, and to the left for the left-handed form.

b. References

1. Elasticity, Plasticity and Structure of Matter, Houwink, Roelof, Dover, 386 pp. (1957) - $2.45
2. Plastics as Corrosion - Resistant Materials, Evans, Verney, Pergamon, 234 pp. (1966) - $4.50
3. The Meaning of Crystallinity in Polymers, editor Price, Fraser P., General Electric, 149 pp. (1967) - $6.50
4. Macromolecules of Living Systems: Structure and Chemistry, Rhinesmith, Herbert L., Reinhold Book Corp., 128 pp. (1968) - $2.25
5. The Biosynthesis of Macromolecules, Ingram, Vernon M., Benjamin, 223 pp. (1965) - $4.95

c. Selected Films

1. Miracle Materials - ALFI, $125. (16mm, B/W, sound, 23 min.)
2. Physical Chemistry of Polymers - STER, free loan (16mm, color, sound, 22 min.)
3. Chemistry of the Cell - I: The Structure of Proteins and Nucleic Acids - MGHT, $250. (16mm, color, sound, 21 min.)

d. Other Teaching Aids

(See earlier listings for sources of models).

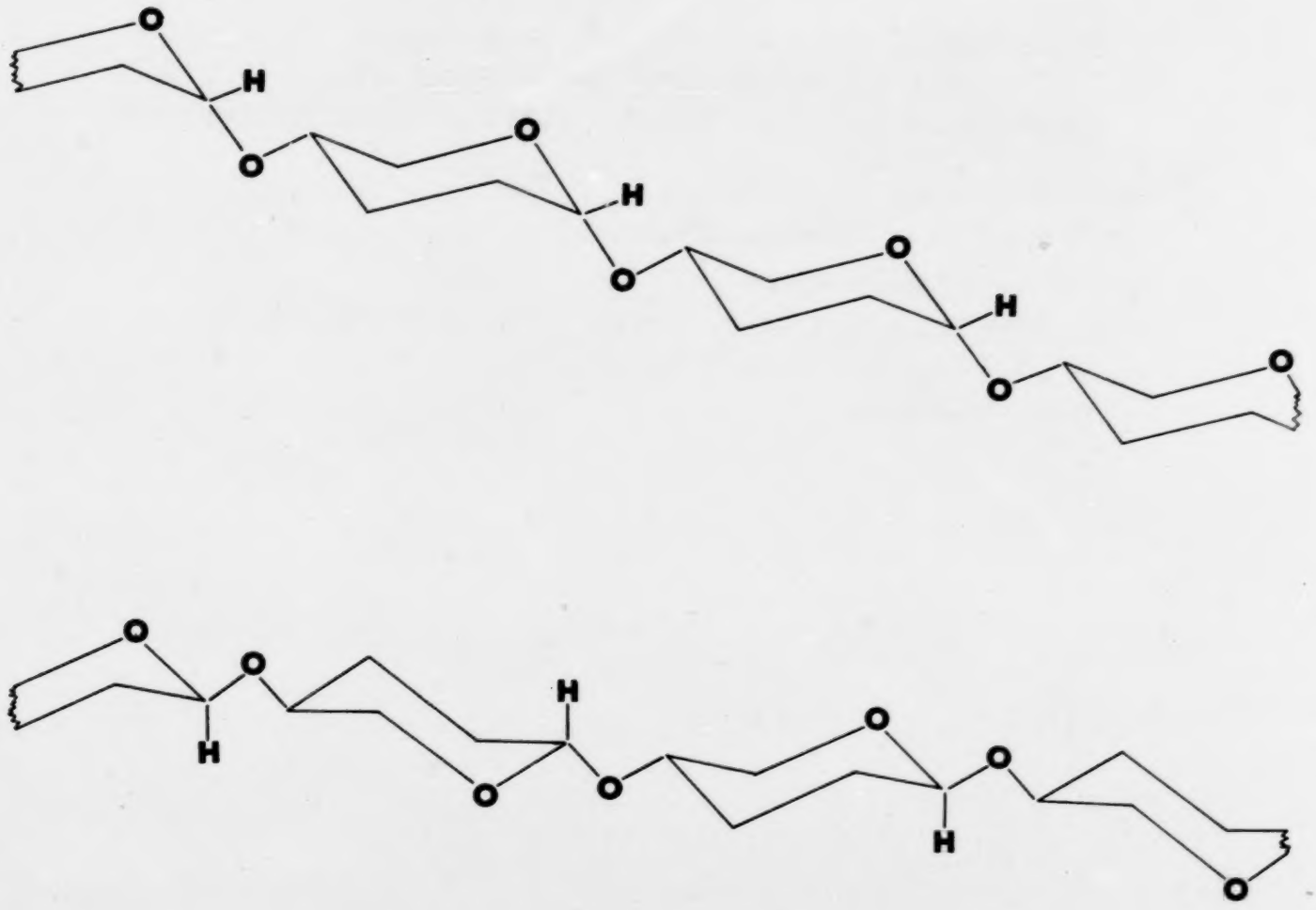
e. Selected Lecture Demonstrations

Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 48, 110, 135, 157, 164, 182.

f. Transparency Master

"α and β Glycosides"

α and β Glycosides



32) INTRODUCTORY BIOCHEMISTRY

a. Textbook Errors Summary

COMPOSITE pK's OF CYSTEINE, Rogers, Samuel J., J. Chem. Ed., 46, 239 (1969)

A variety of physical measurements made on ionized species of amino acids have supported the dipolar or Zwitterion interpretation of the titration behavior. However, the assignment of a pK value to a particular acidic group becomes more difficult as the groups in question become less familiar. The titration of pyridoxine is an example of a complex polybasic compound where the measured pKa values of 5.00 and 8.96 cannot be unequivocally associated with the pyridinium or phenolic groups by using pyridine (pKa ~5) and phenol (pKa ~10) as analogous reference compounds. Using the analogy, one would associate the low pKa with the pyridinium group, and the high pKa with the phenolic group. Careful spectrophotometric analysis of the pyridoxine system has established just the opposite; that is, the low pK is associated with the phenolic group and the high pK with the pyridinium group.

b. References

1. Introduction to Chemistry of Life: Biochemistry, DeBey, H. J., Addison-Wesley, 255 pp. (1969) $3.95
2. An Introduction to the Structure of Biological Molecules, Barry, Michael and E. M., Prentice-Hall, 224 pp. (1969) - $4.95
3. An Introduction to the Chemistry of Carbohydrates, Guthrie, R. D. and John Honeyman, Oxford, 166 pp. (1968) - $4.50
4. Peptides and Amino Acids, Kopple, Kenneth D., Benjamin, 148 pp. (1966) - $3.95
5. The Primary Structure of Proteins (Principles and Practices for the Determination of Amino Acid Sequence), Harper and Row, (1968) - $5.95
6. The Structure and Function of Enzymes, Bernhard, Sidney, Benjamin, 265 pp. (1967) - $3.95
7. Bioenergetics: The Molecular Basis of Biology Energy Transformations, Lehninger, Albert L., Benjamin, 258 pp. (1965) - $3.95
8. Quantitative Problems in the Biochemical Sciences, Montgomery, R. and C. A. Swenson, Freeman, (1969) - $2.95
9. Basic Biochemical Calculations: Related Procedures and Principles, Finlayson, J. S., Addison-Wesley, 336 pp. (1969) - $5.95
10. Design and Function at the Threshold of Life: The Viruses, Fraenkel-Conrat, H., Academic, 133 pp. (1962) - $2.45

c. Selected Films

1. Biochemistry and Molecular Structure - MLA, cat. no. 4181, $165. (16mm, color, sound, 22 min.)
2. Cell Division-Mitosis - EBF, cat. no. S80051, $18. (S-8, color, silent, 3 min.)
3. Cell Respiration - MGHT, cat. no. 613224, $300. (16mm, color, sound, 28 min.)
4. Chemical Machinery - MGHT, cat. no. 613260, $300. (16mm, color, sound, 28 min.)
5. Gateways to the Mind - STER, free loan (16mm, color, sound, 59 min.)

d. Other Teaching Aids

(See earlier listings for models).

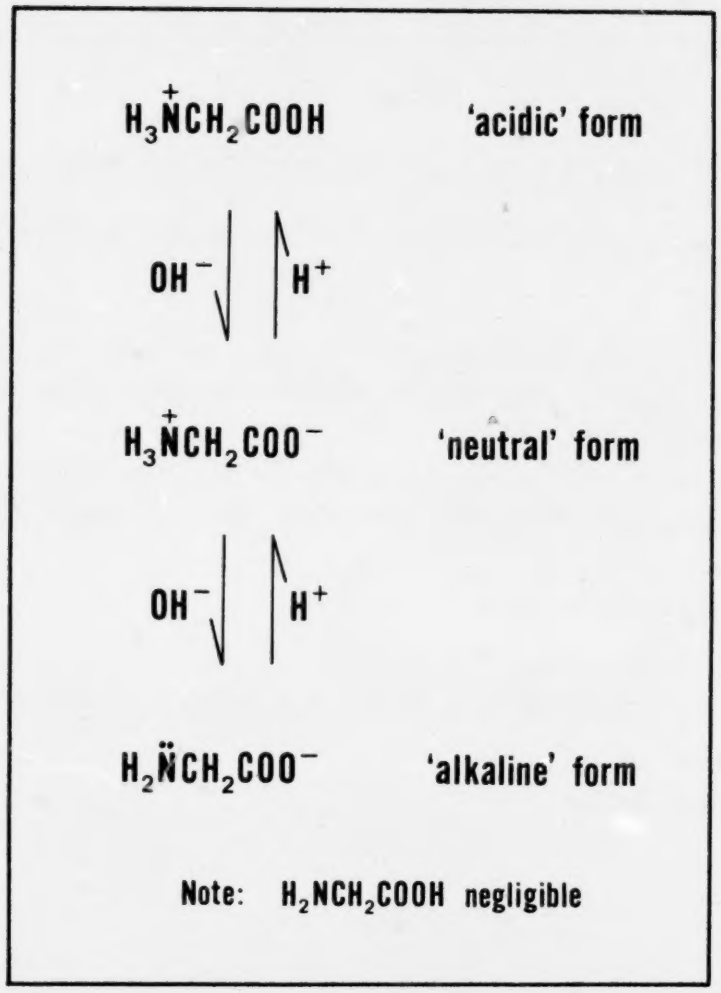
e. Selected Lecture Demonstrations

Consult subject index in Tested Demonstrations in Chemistry, Alyea and Dutton

f. Transparency Master

"Amphoterism of Glycine"

AMPHOTERISM OF GLYCINE



33) GENETIC CODE

a. Textbook Errors Summary

None listed

b. References

1. The Genetic Code: The Molecular Basis for Genetic Expression, Woese, Carl R., Harper and Row, (1967) - $5.95
2. Molecular Biology of the Gene, Watson, James D., Benjamin, 506 pp. (1965) - $6.95
3. The Double Helix, Watson, James D., New American Library, 143 pp. (1968) - $0.95

c. Selected Films

1. Gene Action - EBF, cat. no. 2138, $200. (16mm, color, sound, 16 min.)
2. DNA Transformation Experiment - EAL, cat. no. 81-6058, $23. (S-8, color, silent, 4 min.)
3. Extraction of Nucleic Acids - THORNE, $120. (16mm, color, sound, 10 min.)

d. Other Teaching Aids

1. DNA Action Model, Clarke, Robert F., Charles Schlanker, and Richard Sagness, Burgess, (1968) $1.25
2. Elements of Protein Synthesis, Thomas Peter Bennett, Freeman, approximately $2.00

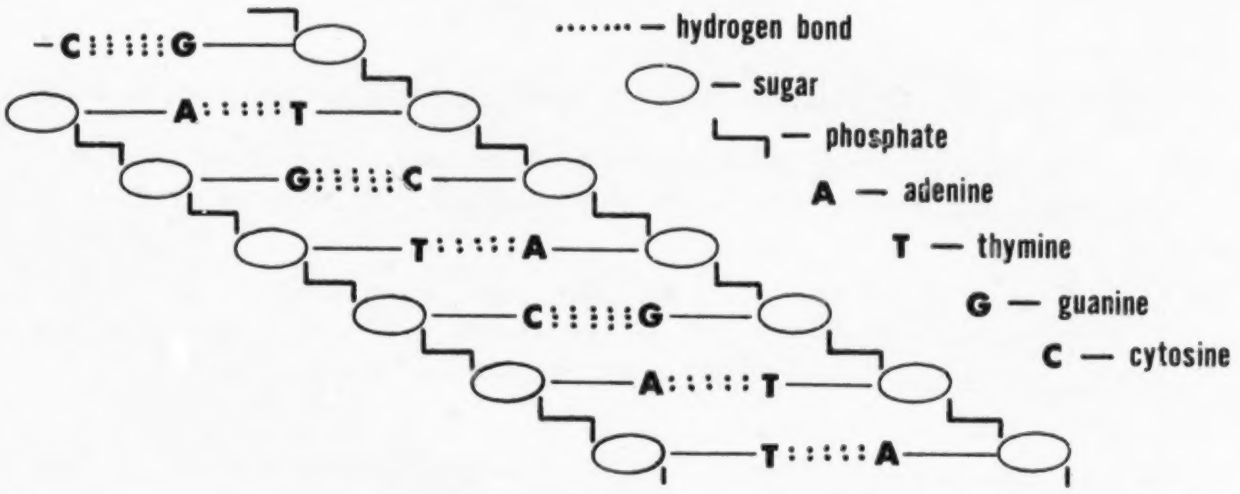
e. Selected Lecture Demonstrations

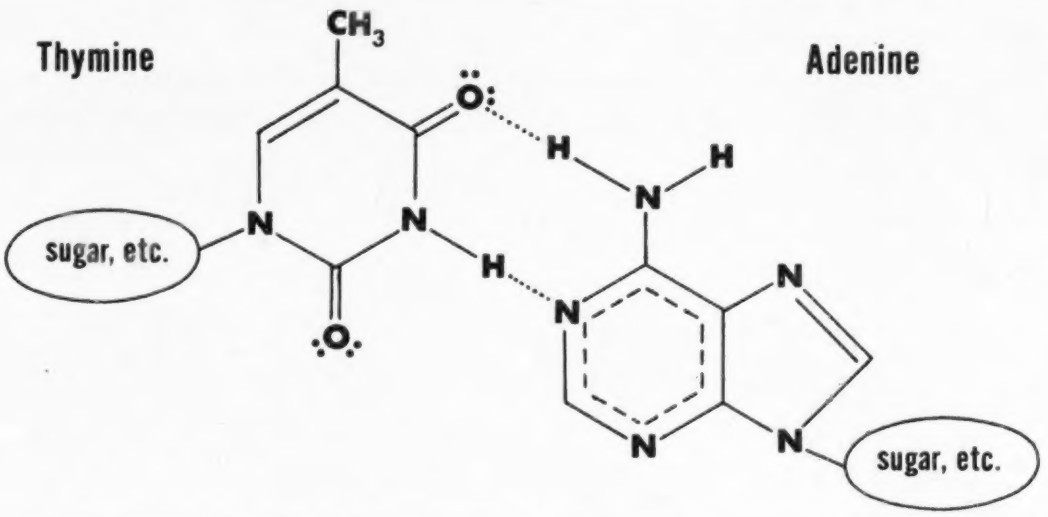
Suggestion: Invite faculty from biochemistry, biology, genetics, medicine for class discussion. Also consider discussions involving science and religion.

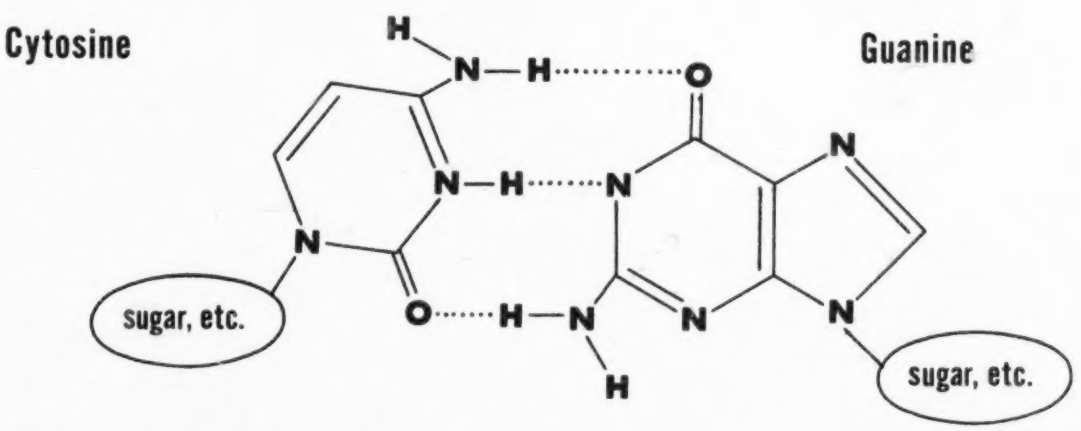
f. Transparency Master

"Base Pairing"

BASE PAIRING







APPENDIX A

LIST OF COMMERCIAL SUPPLIERS

ACADEMIC PRESS, INC.
111 Fifth Avenue
New York, N. Y. 10003

ADDISON-WESLEY PUBLISHING CO., INC.
Reading, Massachusetts 01867

AEC
Audio-Visual Branch
Division of Public Information
U.S. Atomic Energy Commission
Washington, D. C. 20545

AIM
Association Instructional Materials
c/o Association Films, Inc.
347 Madison Ave. (Dept. DC)
New York, N. Y. 10017

ALFI
Almanac Films, Inc.
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CAMBRIDGE UNIVERSITY PRESS
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CHEMICAL EDUCATION PUBLISHING CO.
20th and Northampton Streets
Easton, Pennsylvania 18042

CORF
Coronet Films
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DOUBLEDAY AND CO., INC.
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DOVER PUBLICATIONS, INC.
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EDMUND SCIENTIFIC COMPANY
101 E. Gloucester Pike
Barrington, N. J. 08007

EDUCATIONAL MATERIALS AND EQUIPMENT COMPANY
Box 63
Bronxville, N. Y. 10708

FAC
Film Associates of California
11559 Santa Monica Blvd.
Los Angeles, California 90025

FAWCETT PUBLICATIONS, INC.
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New York, N. Y. 10036

W. H. FREEMAN AND COMPANY PUBLISHERS
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See RAYTHEON

HOLDEN-DAY, INC.
500 Sansome Street
San Francisco, California 94111

HOLT, RINEHART AND WINSTON, INC.
383 Madison Avenue
New York, N. Y. 10017

HOUGHTON-MIFFLIN
110 Tremont Street
Boston, Massachusetts 02107

HR
Harper and Row, Publishers, Inc.
49 East 33rd Street
New York, N. Y. 10016

ICF
International Communication Films
1371 Reynolds Avenue
Santa Ana, California 92705

IFB
International Film Bureau, Inc.
332 S. Michigan Avenue
Chicago, Illinois 60604

INDU
Indiana University
Audio-Visual Center
Bloomington, Indiana 47401

LGC
Longmans, Green and Co., Ltd.
48 Grosvernor Street
London W.1., England

THE MACMILLAN COMPANY
866 Third Avenue
New York, N. Y. 10022

MGHT
McGraw-Hill Book Company
330 W. 42nd Street
New York, N. Y. 10036

MLA
Modern Learning Aids
1212 Avenue of the Americas
New York, N. Y. 10036

NEW AMERICAN LIBRARY, INC.
1301 Avenue of the Americas
New York, N. Y. 10019

OXFORD UNIVERSITY PRESS
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7110 Ambassador Road
Baltimore, Maryland 21207

PERGAMON PUBLISHING COMPANY
Maxwell House
Fairview Park
Elmsford, N. Y. 10523

PRENTICE-HALL
Englewood Cliffs, N. J. 07632

REC
Reinhold Book Corp.
See VAN NOSTRAND

ROB
Peter M. Robeck and Co., Inc.
230 Park Avenue
New York, N. Y. 10017

SCIENCE KIT, INC.
2299 Military Road
Tonawanda, N. Y. 14150

SCIENCE RELATED MATERIALS, INC.
P.O. Box 1009
Evanston, Illinois 60204

STER
Sterling Movies, Inc.
43 West 61st
New York, N. Y. 10023

SUTH
Sutherland Educational Films, Inc.
201 N. Occidental Blvd.
Los Angeles, California 90026

TESTED DEMONSTRATIONS IN CHEMISTRY
See CHEMICAL EDUCATION PUBLISHING CO.

THORNE
Thorne Films
Dept. 113
1229 University Avenue
Boulder, Colorado 80302

TOPS
337 Harrison Street
Princeton, N. J. 08540

UEVA
Universal Education and Visual Arts
221 Park Avenue South
New York, N. Y. 10003

VAN NOSTRAND REINHOLD CO.
450 West 33rd Street
New York, N. Y. 10001

VIKING PRESS, INC.
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New York, N. Y. 10022

JOHN WILEY AND SONS, INC.
605 Third Avenue
New York, N. Y. 10016

WILLARD GRANT PRESS, INC.
53 State Street
Boston, Massachusetts 02109

APPENDIX B

- CHEMISTRY LABORATORY PROGRAMS -

1) Laboratory Safety

The safety programs in most academic laboratories leave much to be desired, not only from the view of accident hazards, but also from the aspect of proper teaching. It is recommended that every effort be made to teach and require proper laboratory safety in chemistry.

Three excellent references are available:

a. Safety in Chemistry Laboratories, Chemical Education Publishing Company (1967) - $3.00

b. The Journal of Chemical Education - continuing series "Safety in the Chemical Laboratory," edited by Norman V. Steere

c. Handbook of Laboratory Safety, Chemical Rubber Publishing Company, 2310 Superior Avenue, Cleveland, Ohio 44114

Some simple precautions are useful in preventing accidents or in minimizing injury in the event of accident:

a. Give students two copies of safety rules and require them to sign and return one copy.

b. Enforce eye protection requirement rigorously. Require routine use of pipet bulb (not mouth).

c. Train laboratory assistants and stockroom personnel in emergency procedures. Periodic unannounced simulated emergencies help maintain preparedness.

d. Post emergency telephone numbers and basic first aid procedures conspicuously in all laboratories.

e. Mark locations of fire extinguishers, safety showers, and eyewash sprays (vegetable sprayers are excellent) with conspicuous signs.

f. Send brief written reports of accident details with person accompanying an accident victim to the medical facility.

For training sessions of instructors and students, safety films may prove valuable. Some which are currently available are:

a. Chemical Booby Traps, General Electric Educational Films, 60 Washington Avenue, Schenectady, N.Y. 12305 (16mm, color, sound, 10 min., $120.)

b. Safety in the Chemical Laboratory, Manufacturing Chemists Association, Inc., 1825 Connecticut Avenue, N.W., Washington, D.C. 20009 (16mm, color, sound, 20 min., $100.)

c. Safety in the Laboratory, Association Instructional Materials, 347 Madison Avenue (Dept. DC) New York, N.Y. 10017 (16mm, color, sound, 8 min., $90.)

d. [Safety Series], Harper and Row, Publishers, 49 E. 33rd Street, New York, N. Y. 10016 (Five S-8 films, color, silent, $25. each)

- Basic Laboratory Safety
- Handling Reagents
- Accident Prevention
- Laboratory Emergencies
- Laboratory First Aid

2) Films for the Laboratory

A wide variety of 16mm and Super-8 films are now commercially available for introducing laboratory techniques or specific experiments. For descriptive catalogs, write:

a. AIM - see Appendix A
b. CORF - see Appendix A
c. EAL - see Appendix A
d. EBF - see Apprendix A
e. HR - see Appendix A
f. ICF - see Appendix A
g. Kalmia Co., Concord, Mass. 01742
h. Macalaster Scientific Co. - see REC Appendix A
i. MGHT - see Appendix A
j. W. B. Saunders, West Washington Square, Philadelphia, Pa. 19105
k. Wiley - see Appendix A

3) Laboratory Separates

For the teacher who prefers an individualized collection of experiments to a more conventional laboratory manual, the new Laboratory Separates Programs should have considerable appeal. Two such programs are now active in college chemistry and other publishers are planning ventures. For details on the current materials, write: W. H. Freeman and Willard Grant Press - see Appendix A

APPENDIX C

- THE AC_3 CLEARINGHOUSE FOR FILMS AND SLIDES -

Teachers willing to share their production of instructional materials in the form of silent 16mm or Super-8 films or 35mm slides are invited to submit copies to the AC_3 Clearinghouse for duplication and distribution at cost. For details of submission procedures or order forms for Clearinghouse materials, write:

Rod O'Connor
AC_3 Clearinghouse
Department of Chemistry
The University of Arizona
Tucson, Arizona 85721